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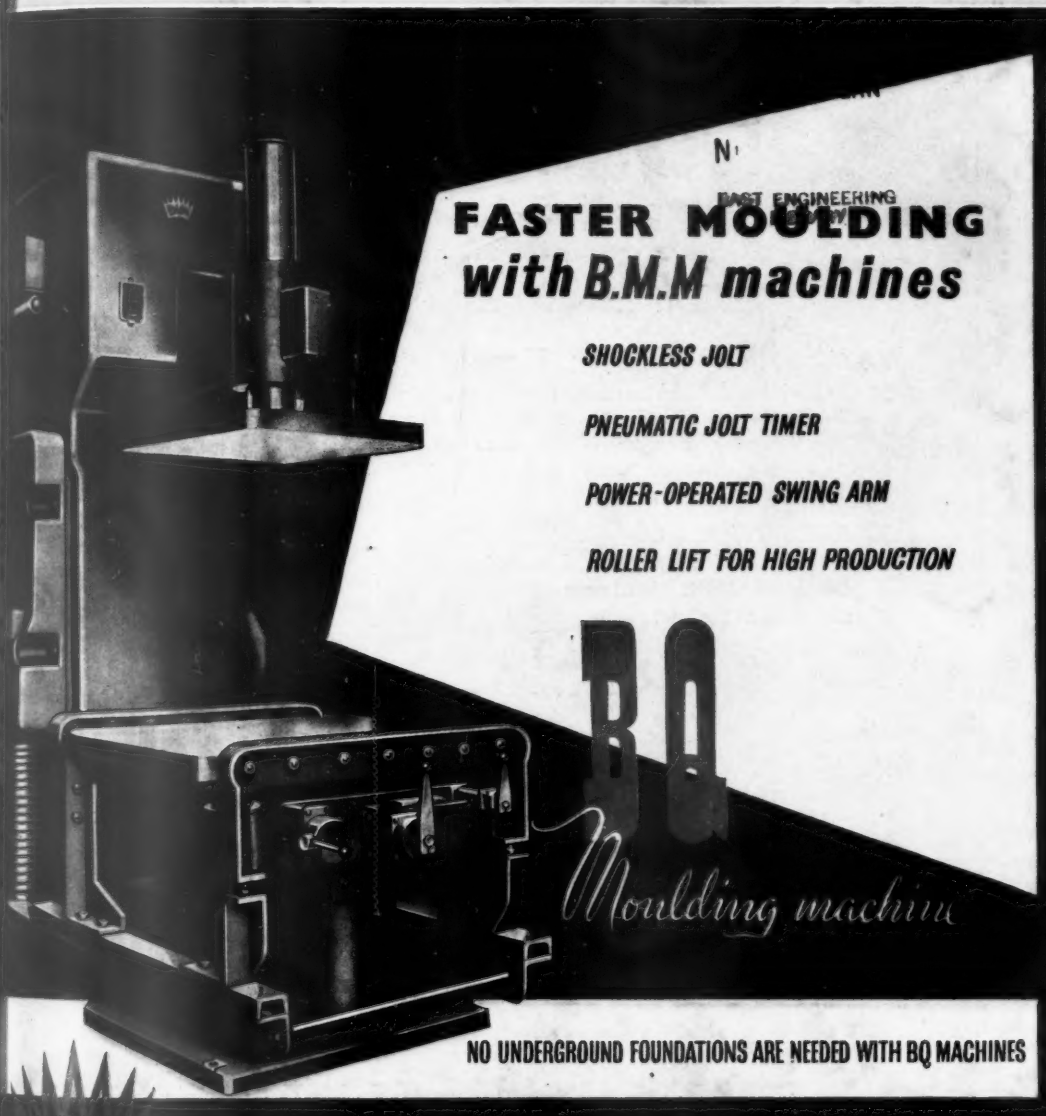

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Aggressive Salesmanship

Commenting on the statistics revealed by Penton's *Foundry List*, Mr. William G. Gude, the managing editor of our American contemporary, *Foundry*, referred in some detail to the fact that there were now some 25 per cent. fewer grey-iron foundries in the United States than there were but ten years ago. He gave three reasons, which were, briefly, the lower unit costs inherent in large-scale production; failure of firms to adopt improved methods which would enable them to remain competitive, and ineffectual selling methods. The first condition is one about which the owner of a small foundry can do nothing, the second may be due to lack of finance, but the third is something definitely within his own control.

A typical example of what can be done about selling methods is a challenging folder recently sent out by the Advance Foundry Company of Dayton, Ohio. On the front is pictured a rather worried-looking designer gazing at a display of pieces of metal bearing such labels as "XL 50," "Does-everything Metal," "New ZZ Metal," "56th Century," and so on. Amongst these, the only metal which he can recognize with confidence in its established properties is "Grey Iron" and the caption emphasizes this with the moral, "the best production material is often right under your nose." Inside the folder, readers are informed that there are (in America) eight basic types of modern grey-iron castings; there are 14 types of this material that can be cast, each having different characteristics and properties and, finally, that no fewer than 30 types of coatings can be applied. Thus, in minimum space, a maximum amount of interest has been conveyed to the designer as to the potentialities of cast iron.

Still on this subject of forthright salesmanship, we were recently impressed by a customer conference organized by a large grey-iron foundry in this country. Here, customers, by means of a lecture session and a visit to the works, learnt much more about what they could get from this foundry than they could receive from a dozen calls from a representative backed up by correspondence. The idea of a "customer conference" is a notion not too extravagant for emulation by concerns of more modest proportions than the one visited. Such an event needs to be well stage-managed and, with but a handful of customers participating, a degree of informality could pervade the meeting. Always, however, the main objective of sales and service must be uppermost in the minds of the organizers and this message must be intelligently and indeed aggressively "put over." A visit to the actual foundry, through its tidiness and visible evidence of technical control, vitally aids salesmanship. Moreover, at such a conference the founder would learn first hand about the major "grouses" of his customers.

ABBF London-area Notes

At a meeting of London-area members of the Association of Bronze and Brass Founders, held at the Clarendon Restaurant, Hammersmith, on September 11, a number of subjects of general interest to copper-base founders were discussed. Topics included: Liaison with other foundry and allied organizations; the European Committee of Foundry Associations; International Foundry Apprentice Competition; draft code of Regulations for Non-Ferrous Foundries; publicity; the International Foundry Congress held in Stockholm, and impending publication of the "Companion Volume" to the BSI specification for brass and bronze castings. On the subject of technical advice, it was stated that following the conclusion of the Conditional Aid Scheme, it had been decided to form a Technical Advisory & Research Committee of the Association to co-operate with the British Non-Ferrous Metals Research Association to develop research on lines which are of advantage to members, and to form some organization whereby technical advice can be made available. There had been some delay in getting the liaison committee working, but a meeting with the Research Association would shortly be held to consider policy for next year.

The question of suitable topics and subjects for future research was discussed at length and suggestions for work on "alternative gases to CO_2," and "sands and surface finish," were put forward. It was suggested that the secretary should write to all members of the Association to ascertain their further ideas or suggestions.

Technical Report

Members during the hearing of the technical report were informed of the following matters:

Repeat Tests on Test-pieces representing Castings: The British Standards Institution had convened a conference to which some 46 organizations had been invited to discuss the number of test-pieces required to pass tests in the event of the original test-piece failing. The conference had been called because standards for malleable cast-iron were being revised and there were differences in the requirements of the ferrous and non-ferrous "Codes of Procedure." In the case of the malleable industry, two bars out of three repeat tests were required to pass and in brassfounding, one out of three was called for. The ABBF representative had strongly opposed any proposal which would detract from the present procedure. He had been successful in clearing considerable misunderstanding as to the purposes for which test-bars were produced. The conference chairman had suggested that the standard BS 1367 should be circulated by the Institution for comment.

Aluminium Bronze (AB.2.): Considerable discussion was still taking place on the question of the proposed revised properties for the alloy AB. 2. The ABBF Council had agreed that the new properties should be adopted after the matter had been discussed with the objecting members. A date had been fixed for the four objecting members to meet Mr. French. (This meeting has now taken place and was extremely helpful to the majority of members present.)

Sulphur in Gunmetals: The chairman of the technical committee reminded the meeting that considerable anxiety had been expressed as to the effect of sulphur in gunmetals, particularly with the increasing use of heavy oil-fuel for melting. He was pleased to be able to report that it had now been decided that there was no detrimental effect with sulphur up to 0·3 per cent. in the alloys.

On the question of liaison which the ABBF president was trying to arrange with the presidents of other kindred societies (so as to deal on the basis of "foundry-industry" representation in discussion with outside bodies*) it was reported that favourable reactions to the proposals had been received from all except one of the societies approached.

* "Why Not Revive Foundry Liaison," JOURNAL August 29, 1957, p. 242.

Correspondence

COLOURED CORES

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—We think that the following might be of some interest to your readers who are using the CO_2 method for producing cores.

We are using a brand of sodium silicate (which gives a mix of the same basic colour as the sand) and, in order that the oldest cores are used first, we are using differently coloured dyes which are initially mixed with the sodium silicate. As a result we are able to differentiate between cores of otherwise similar appearance. Whilst our system employs one basic colour per week, the scheme could also be applied to differentiate between daily production if required.—Yours, etc.

P. RASTALL.

J. Rastall & Son, Limited,
345, Chester Road,
Manchester, 16.
October 19, 1957.

European Foundry Apprentice Competition

A selection panel consisting of Mr. J. W. Gardom; Mr. J. Bamford; Mr. F. D. Roper and Mr. M. Martin, has chosen three young men: Mr. Edward Sykes (H. Downs & Sons (Huddersfield), Limited); Mr. Richard Spencer (James Smethurst & Son, Limited, Warrington), and Mr. P. Roberts (Bridge Foundry Company, Limited, Wednesbury), to represent this country in the European Foundry Apprentice Competition to be held at Stuttgart during the week commencing November 25. Dr. J. G. Pearce, Mr. Gardom and Mr. Bamford are going to Stuttgart as judges and Mr. J. Collet and Mr. W. S. Matthews, for the Council of Ironfoundry Associations, are to be present as observers. Two of the boys are learning iron moulding and the third is engaged in an aluminium foundry.

Latest Foundry Statistics

Light Alloy Castings

The Ministry of Supply announces that the output of aluminium-alloy castings during July was 1,675 tons from sand moulds; 3,391 tons as gravity-die, and 1,327 tons as pressure-die-castings. The production of magnesium and magnesium-alloy castings was 234 tons.

Copper-base Castings.

The British Bureau of Non-Ferrous Metals Statistics report that the output of castings during August was 5,495 tons. Production figures for the first eight months of this year reveal much the same trend as last year, the total this year so far being 11 tons lower than last.

Stainless and Heat-resistant Investment Castings

By R. Taylor

Mr. R. Taylor, production manager of the investment foundry at Firth-Vickers Stainless Steels, Limited, Sheffield, received his technical education *via* a London Engineering Institute and at Rotnernam College of Technology. In 1940 he joined the research department of William Jessop & Sons, Limited, and in 1949 transferred to B.S.A. Group Research Centre. He held this position until his present appointment, in 1952.

Large numbers of founders, both at home and abroad, realize the possibility of incorporating investment-casting sections in their foundries, and this practical article will be of distinct help to such founders. The Paper commences with a brief survey of the history of the lost-wax process of precision casting, with its origin in the Shang Dynasty of China (1,500 B.C.), *and continues with recent developments; economy considerations, and modern production methods. The Author proceeds to give details of the various aspects of the process as employed at the precision foundry of Firth-Vickers, Sheffield, under the following headings: Dies; production of wax patterns; soluble-wax technique; assembly of patterns; primary investment; boxing; secondary investment; mould drying; de-waxing; firing, and casting. The Paper concludes with considerations of the process, such as alloy composition; dimensional accuracy,* etc.

The "lost-wax" casting process, notwithstanding its present-day advanced techniques and various forms of production, employs precisely the same principle as that used in centuries B.C. by Chinese, Egyptian, Greek and other craftsmen in various parts of the world. Stated simply, the process includes the following steps which indicate clearly the principles involved:—

(1) The production of a pattern in wax, this pattern being a three-dimensional model of the shape and size to be reproduced in metal;

(2) the investment or "clothing of the wax-model in a bulk of clay, plaster or other suitable refractory composition to form a mould, in one operation, as distinct from the moulding of only half or some other proportion of the surface of the pattern, at one time, *i.e.*, the pattern is more or less completely surrounded in one operation by the moulding material;

(3) the baking of the wax-model containing "brick" or mould to: (*a*) melt and burn out the wax, (*b*) dry and harden the mould, and (*c*) preheat the mould for casting (if required);

(4) pouring the metal into the prepared mould *i.e.*, into the cavity left in the refractory mass by the removal of the wax, and

(5) stripping or removal of the mould material from the casting, which is, of course, an exact replica of the original wax model.

Early Progress

Amongst the earliest examples of lost-wax castings of superb craftsmanship are those attributed to the Shang Dynasty of China (around 1500 B.C.), various Egyptian dynasties as far back as 2500 B.C., and the ancient civilization of Central and South America. In all these cases, gold or bronze jewellery, or similar art objects predominate. In comparatively recent times, for example around A.D. 500 and 1500, a form of lost-wax moulding has apparently been used as a supplementary process to sand or loam moulding for casting large objects such as life-size statuary utilizing a skin of delicately carved wax on a wooden former and sometimes augmented by the separate casting of head, limbs, etc. It was on the continent that the process acquired the title *Cire Perdue*, the French equivalent of lost-wax.

Recent Developments

Around the beginning of the present century the process was adopted by the dental profession for the production of gold inlays, etc.; soon afterwards the jewellery trade developed similar methods for the relatively large-scale production of intricate noble-metal art castings. At this stage, of course, there developed the necessity for dies to produce many replica wax patterns, instead of the "one-off" original art objects, hand carved in wax.

For both of these modern applications, the amount of metal melted and cast at a time was, and still is, very small, and the technology of casting has centred on centrifugal methods in order to achieve the requisite reproduction of fine detail.

Approximately 20 years ago, the development of a cobalt alloy (Vitallium) for surgical uses extended the application of the process still further, and it was this background, plus special urgent needs that arose during the second World War, that really put lost-wax precision casting on the industrial map. The outstanding factor which gave rise to adoption of the process by the aeronautical industry was the demand for jet-engine components

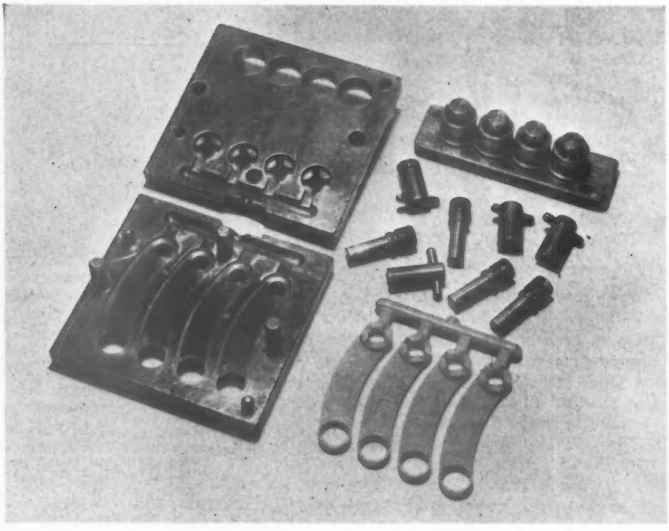


FIG. 1.—*Components of a four-impression die, together with the wax pattern produced. This method can effect considerable economies where long runs are envisaged.*

(turbine blades, etc.) in highly-alloyed heat-resistant materials which could not readily be machined or forged to the complex shapes and precision required.

The same firm (Austenal Laboratories Inc., New York, who originated the alloy Vitallium) pioneered the development of industrial precision casting of aircraft parts such as turbine blades. By sheer coincidence the Vitallium cobalt-type alloy was found to possess remarkably good high-temperature properties. As a result of Anglo-American co-operation in the metallurgical field, process details were supplied (*via* a secret report) to a number of eminent firms (aircraft and alloy-steel producers) in Britain, and most, if not all, of these then set up their own precision-casting pilot plants.

Economy Achieved

It was soon realized, particularly by large engineering concerns, who, for every ton of steel bought, found that they had an exceptionally large proportion of this weight for disposal in the form of turnings, that the adoption of the process could effect substantial economies in the production of small components, especially those of complex shape. Engineers also found that new designs for components required to be made by other mass-production methods, such as forging, stamping, etc., can often be finalized more quickly and cheaply by the production of prototypes made as investment castings; dies and raw materials for the latter being much cheaper and more readily available. It became obvious that designers now had enormously greater scope on two basic counts, *viz:* (1) geometry—it being possible to cast complex internal and external surfaces virtually or actually impossible to produce by machining, and (2) economics—whereas one precision-made, investment-casting wax-pattern die can be utilized for the production of hundreds of thousands of complex-shape cast components, machining from stock calls for the same expensive and time-consuming operations on every component so produced.

Thus, thousands of years after some inspired unknown person first conceived the idea, the lost-wax investment casting method has come into its own as an important industrial process which forms a vital link in the exceedingly complex web of technology that supports present-day civilization.

Modern Production Procedures

Present-day production procedures of precision casting are by no means confined to what might be termed "the conventional lost-wax process," but are perhaps surprisingly varied, and may be somewhat crudely classified as follows:—

Solid-mould Techniques

(*a*) *Single-investment Type* in which the pattern assembly (usually made of wax or plastic) is mounted in a moulding box and surrounded by, or invested with, a fine slurry. Before consolidation of the slurry is effected it is usually subjected to vacuum treatment to remove air-bubbles which otherwise may be trapped against the surface of the wax assembly, thus causing corersponding protuberances of metal on the subsequent castings.

(*b*) *Double-investment Type* in which the pattern assembly (usually made of wax or plastic) is first given a spray or dip-coat called the primary investment, followed some hours later by investing in a relatively coarse slurry to form the solid mould.

Shell-mould Techniques

(*c*) The pattern-assemblies are repeatedly dipped in a slurry and sprinkled with refractory particles to build up a relatively thick dip-coat which, with or without backing or other support, forms the mould. The patterns are generally made of wax, plastic or frozen mercury (Mercast Process).

(*d*) Mixtures of fine sand and resinous chemicals (in the form of a fine powder) are dumped for a short time (approximately 15 sec.) on to heated metal patternplates (approximately 250 deg. C.) to form a thin-walled half-mould or shell. The heat pick-up in the sand-mix, adjacent to the pattern-plate, develops the resin bond. This process is the well-known Croning or "C" process and is generally called shell-moulding.

Piece-mould Techniques

(*e*) Permanent or semi-permanent patterns in metal, plaster, etc., are mounted in suitable frames or boxes, and part-moulds made by ramming or pouring in a mixture of suitable filler and bonding material, *e.g.* (1) sillimanite flour and silicon-ester bonding fluid. (2) Sand moistened with sodium silicate subsequently hardened by gassing with carbon-dioxide (CO_2 Process). The various mould sections are later accurately fitted together, prior to casting.

Flexible-mould Technique

(*f*) For metals and alloys having relatively low casting temperatures (up to a few hundred deg. C.), flexible moulds, made of neoprene or silicone-rubber with various refractory fillers, can be used repeatedly; this process also avoids the use of an expendable pattern for each casting.

Each type of manufacturing technique has many variations, particularly with respect to the materials used, which are usually determined by the metal or alloy of which the castings are made. Strictly speaking, of course, conventional "die-casting" is a type of precision-casting. With the advent of resin-bond shell-moulding and other techniques which do not involve the use of an expendable pattern, the term precision casting is no longer synonymous with lost-wax casting; and it is highly desirable that only those processes involving the use of expendable patterns should be designated "investment casting" or "precision-investment casting."

Firth-Vickers Method

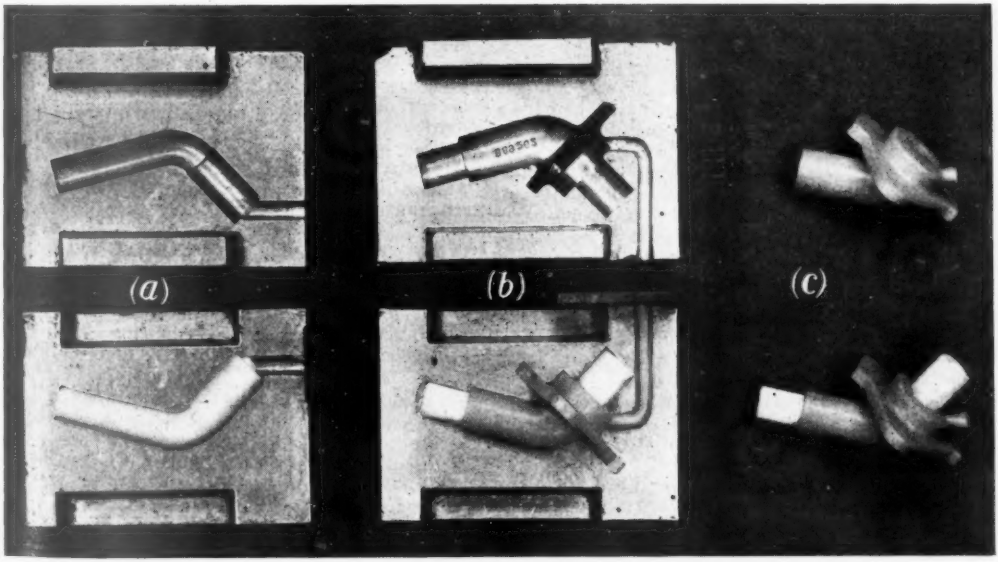
The main manufacturing technique operated by Firth-Vickers precision foundry is one of the forms of the lost-wax process, *viz.* the double-investment type. In all probability this is still the most widely used form of lost-wax production of industrial parts, but it will be appreciated that each plant, according to the type and class of work undertaken, the alloys used, its space and equipment limitations, etc., will develop its own "know-how" and special techniques to solve particular problems. Accordingly, in the account which follows, only a few of the important technical aspects of production can be described.

The various stages in a typical double-investment process may be itemized as follows:—(1) Production of master pattern and/or wax-pattern die; (2) production of wax patterns; (3) mounting or assembly of wax patterns; (4) primary investment of wax assembly; (5) boxing of primary-invested assemblies; (6) secondary investment; (7) mould drying; (8) de-waxing; (9) mould firing; (10) casting; (11) fettling; (12) heat-treatment; (13) final inspection, and (14) warehousing.

Dies

For each casting a wax-pattern is first made by injecting liquid or semi-solid wax into a suitable die, sometimes under considerable pressure. Three

FIG. 2.—*Stages in the production of cored patterns by the soluble-wax process: (a) two halves of the core die, the soluble-wax core can be seen lying in position in the lower half; (b) composite-die parts, locating the core, round which is cast the wax pattern. The completed pattern with the cast-in core can be seen in the lower half; (c) another view of the composite pattern/core, and (d) the final wax pattern with the core taken out by solution of the core wax in water.*



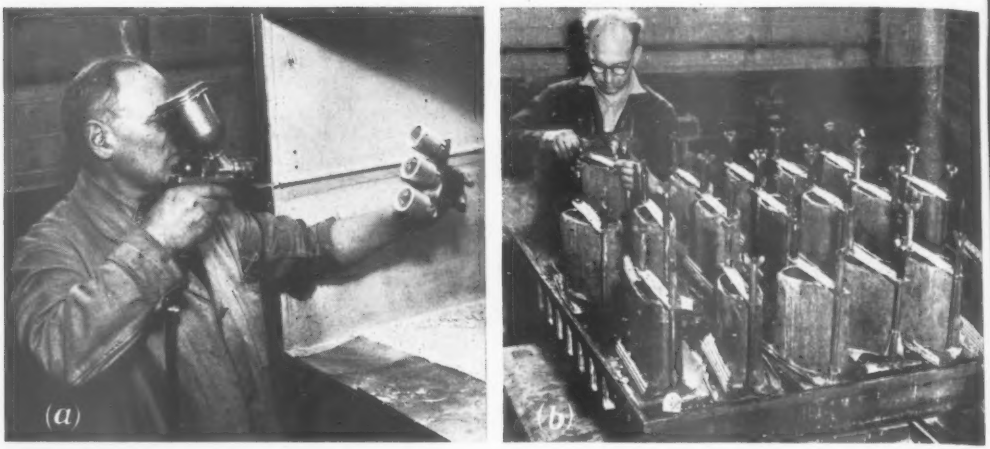


FIG. 3.—*Views of production techniques employed at Firth-Vickers precision foundry: (a) Wax patterns assembled as a "spray" or "tree," are coated with a fine slurry of zircon flour by means of a spray gun. This coating forms the smooth refractory coating of the mould cavity, and (b) shows an operator attending to the mould assemblies on the table of an electro-magnetically operated vibration unit. It is claimed that the use of universal mould-base clamps in conjunction with an expendable sheet of corrugated cardboard effects numerous advantages.*

types of die are in common use; they are:—(*i*) Machined dies (generally made of steel); (*ii*) white-metal (low-melting-point alloy) cast dies, and (*iii*) non-metallic-bond cast dies (hard plaster, sulphur-graphite, etc.). In the majority of cases, precision-machined steel dies are called for, as they possess the following advantages: Long production runs are possible; many thousands of patterns being produced with little or no maintenance cost; the dimensions and finish maintain a higher standard for a longer time, and venting problems (escape of air on injection) are easier to overcome.

It should be noted that it is generally the complexity of the shape and precision and not the quantities required that determines whether a machined die is specified. If the quantities be large, so much the better, since the die cost is spread over a large number of components, and then represents a small percentage of the total cost. However, if the number of castings required is small, the component may be so difficult and costly to produce by alternative means, that it may still be cheaper and expeditious to manufacture as an investment casting, even if the die-cost represents a high proportion of the total. Precision machined dies are usually made direct from the customers' drawing of the component, but incorporating suitable modifications where advisable. Critical surfaces of components, *e.g.* where very close tolerances are involved, for fitting or for threads, etc., required, are cast with a local machining allowance, generally 0·020 to 0·030 in.

Where the total numbers required are not more than several hundred off, and considerable accuracy on certain dimensions is still required, relatively soft white-metal-alloy dies may be produced by casting, but in these cases an accurate well-finished metal, hardwood, or plastic master pattern is required. This master pattern is required to have a nominal 2 per cent. contraction allowance, except on heavy sections, where present, these having rather more than 2 per cent. as indicated by experience. Generally, the master-pattern should also incorporate the casting runner, so as to facilitate the manufacture of this as an integral part of the wax pattern as extracted from the die.

For components having sufficiently complex shape and/or other reasons to justify manufacture as an investment casting, and which require no high degree of general accuracy in the as-cast state, cheaper dies can be made from exceptionally hard plaster. As with cast-alloy dies, a suitable master pattern is required.

Where the "numbers-off" justify, and the component size and shape is suitable, the precision-machined dies can be advantageously made with several impressions, *i.e.* a multiple pattern cavity (Fig. 1), thus enabling one wax-injection operation to produce several patterns simultaneously instead of only one at a time. Such a die is particularly called for where large numbers of small components are required quickly, and the extra cost is in such cases more than recovered.

Production of Wax Patterns

The production of wax patterns is almost a craft in itself, and demands specialized knowledge and experience to cope with the multifarious problems posed by the infinite variety of shapes required to be produced. Apart from the actual construction of the die, as affecting venting of the die cavity and other problems, there are six major factors which

influence the production of a satisfactory pattern, *viz:* (*a*) Temperature or physical state of wax on injection; (*b*) rate of injection; (*c*) pressure of injection; (*d*) time and pressure of injection sustained after the die cavity is filled; (*e*) temperature of the die during injection, and (*f*) thermal and dimensional characteristics of the wax-blend used. The efficient co-ordination of these and other variables to produce excellent wax patterns calls for maximum flexibility of operation *i.e.* ability to "ring the changes" at will, in order to establish quickly the ideal conditions called for by any one of hundreds of dies, whether the demand be for 12 or a thousand off. without prejudice to other work already being produced. The equipment used is accordingly designed to permit full scope for the experienced operator to control at will the injection conditions on every operation. This object is accomplished in the main by means of a multiplicity of electrically-heated, thermostatically-controlled wax-holding units set to hold wax blends in the just-fully fluid condition; large numbers of syringes to hold relatively small charges of wax till the desired temperature and condition is attained, the wax almost invariably being injected in the plastic state, according to the needs of the particular die being used, and hand-operated or compressed-air-driven rams (to discharge the wax from the pump cylinder into the die) the latter being fitted with rapidly adjustable regulators for controlling the rate and pressures of injection.

Unless the correct injection technique and wax blend is used, the wax-patterns produced will suffer from one or more of the following main defects: (*a*) Hot-flow lines; (*b*) cold-flow lines; (*c*) short-running, including lapping; (*d*) entrapped air bubbles; (*e*) excessive or uneven shrinkage, and (*f*) warpage on cooling to room temperature. Exceptionally difficult patterns *e.g.* those with large areas of thin section may demand a wax blend with an especially long plastic range *e.g.* Wilkins Campbell Grade 129/68B. The wide temperature range between the fluid and solid conditions enables the injection pressure to feed the whole of the pattern cavity before the wax, cooled by the die, becomes too stiff to flow.

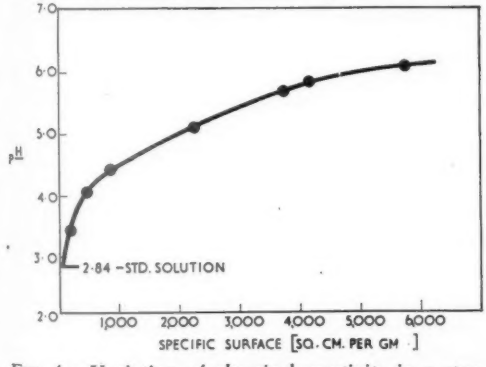


FIG. 4.—*Variation of chemical reactivity in a standard acid solution indicated by pH changes, as a function of specific surface.*

Soluble-wax Technique

The wide scope afforded the designer by investment casting has been appreciably increased by the advent of what is known as the "soluble-wax core technique." Previously, the shape of internal cavities in precision castings had to be limited to those which could be produced by metal core-pieces assembled with the die, and subsequently stripped without damaging the shape of the wax pattern, or alternatively those formed by joining separately produced wax-pattern pieces. Now, however, the shape of the internal cavity can be that of any shape that can be produced as a solid, since the soluble-wax core technique consists of the production of a pattern, of water-soluble wax, in a separate die complete with core-prints, and the use of this soluble-wax core in the ordinary wax-pattern die, in lieu of a metal core piece or pieces. The composite wax pattern is subsequently left for several hours in cold water to dissolve out the soluble wax thus leaving a conventional lost-wax pattern having the internal shape desired (Fig. 2). The normal wax as used for patterns is, of course, insoluble in water, though soluble in organic solvents.

The legitimate application of this technique is, of course, in view of the added cost, generally limited to those cases where metal cores would be "unstrippable."

MOUNTING OR ASSEMBLY OF WAX PATTERNS

After passing inspection, the individual wax patterns are then mounted, by "welding" with a hot spatula, on to a suitably designed wax-runner system, to form a pattern assembly correctly oriented to satisfy at least the following three major requirements:—displacement of air on investment; efficient feeding, and ease of parting-off and avoidance of damage to some castings whilst cutting off others, *i.e.*, unimpeded straight-line cuts. Depending upon the shape and size of the pattern, there may be from one to several hundred patterns mounted on an assembly, but in view of the comparative rarity of single patterns, the common terms used to describe a plurality of mounted patterns such as "assembly," "spray," "tree," or "cluster" are applied also to the case of single patterns.

Feeder System

The economy of the process hinges, to a large extent, on the number of patterns that can be mounted together to form a "production unit," *i.e.*, handled as one mould through the investing, dewaxing and casting operations; in addition, the amount of mould material, *i.e.*, investment used per assembly of patterns, should be as low as is safely practicable. For these reasons, as well as the varying requirements of the geometry of the many different components produced, a large variety of "prefabricated" runner systems are available from dies specially made to produce these *in toto* by pouring or injection of reclaimed wax.

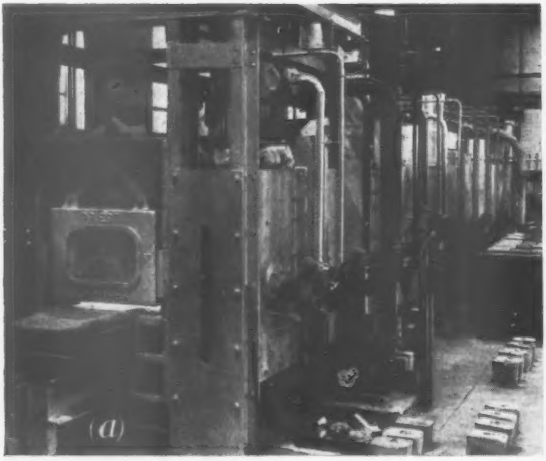


FIG. 5.—*View of further processes involved in the production of investment castings: (a) After de-waxing, the investments are loaded on to refractory slabs and pass into a 34 ft.-long tunnel furnace, the investments being fired at 1,000 deg. C., and (b) gravity casting steel into a fired investment, the steel is melted in a 25 kw. radio-frequency furnace.*

The runner-system dies are generally made quite simply by casting low-melting-point alloy into wooden pattern boxes, the wood patterns being, of course, identical to those required to be produced in wax.

Primary Investment

The wax assemblies are sprayed with and/or dipped in a zircon-flour slurry which subsequently forms the smooth refractory coating of the mould cavity (Fig. 3*a*). The dip or spray coat is sprinkled or "stuccoed" with sand to provide a rough surface, to provide a key for the secondary investment or backing material. During overnight drying the dip-coat bond is developed by gelation.

Boxing Primary-invested Patterns

Subsequently, the assembly is mounted in a flask or moulding box. Even this apparently prosaic stage in the process has called forth considerable ingenuity and variety of practice from one plant to another. Well-known practices include (*a*) sealing of wax-assemblies and wax-coated metal flasks to metal baseplates, with or without temporary waxed-paper lining extensions; (*b*) sealing of wax assemblies and wax-impregnated cardboard flasks to metal baseplates with wax, and (*c*) similar to (*a*) but the flasks made of heat-resisting steel to survive a useful number of firings with the mould still encased up to the time of "knock-out" instead of being removed from the mould prior to, or after, dewaxing. Practice at Firth-Vickers makes use of mild-steel containers with vaselined brown-paper linings and universal-mould-base clamps, in conjunction with an expendable small sheet of corrugated cardboard. (Fig. 3*b*.) The advantages of this practice are that the universal clamps fit any shape or height of box in the normal range; the clamps have a quick turn-round, the corrugated-cardboard gasket permitting safe stripping for re-use immediately after investing, whereas when wax sealing is employed, the base is usually tied-up until heat may safely be applied; the messy wax-sealing and subsequent cleaning operations also are avoided. Attachment of the flask to the base is a positive clamping action, without the handling dangers of the weak wax joint; the cross-bar clamp over the top of the flask forms a safe carrying handle and also serves to break the flow of slurry on investing and incidentally assists the breakage of bubbles in the investment at the time of pouring; in addition, the wax-base of the assembly adheres more firmly to the corrugated cardboard base than to a metal plate, however clean, due to the porosity of the former, and the corrugated cardboard base provides a useful amount of "give" should unequal pressures develop on the assembly during investing.

Secondary Investment

The most important stage of the whole process is secondary investment, and is certainly the one most easily capable of giving rise to trouble. Briefly, this stage consists of the production of a slurry and the pouring of it into the moulding flasks so as to envelop completely the primary invested assemblies contained therein. This is followed by consolidation of the slurry to a rigid densely-packed mass, with the separation of excess liquid (by means of low-amplitude high-frequency vibra-

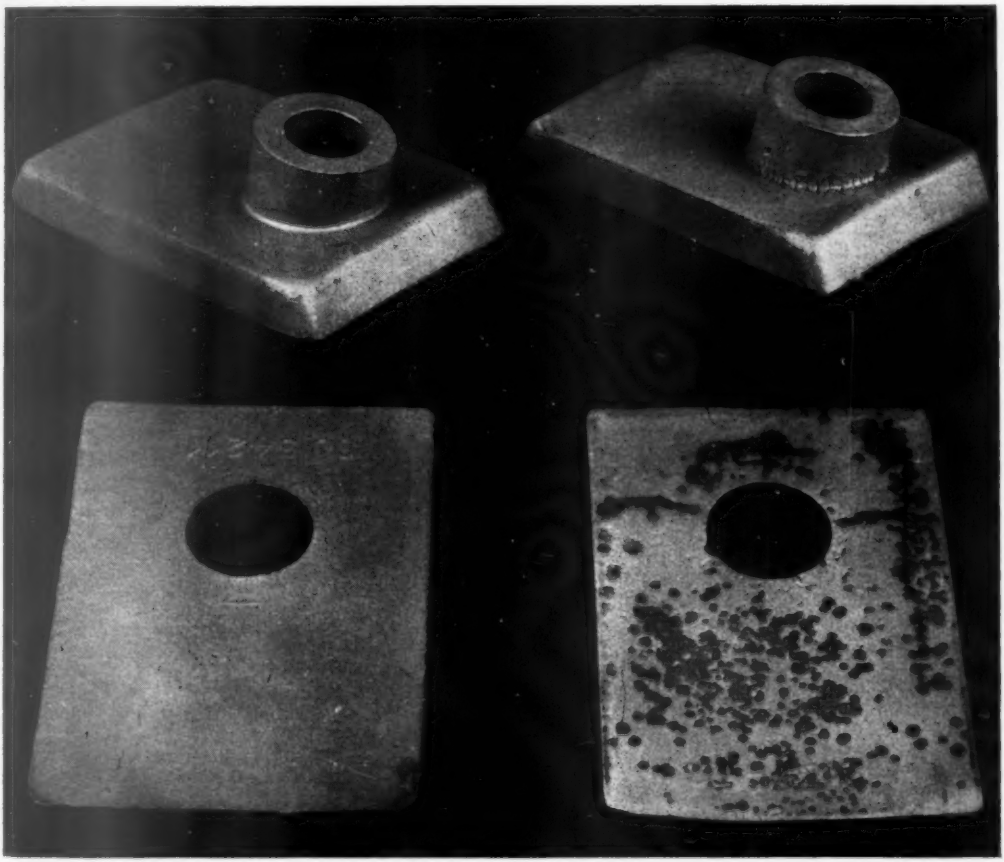
tion, usually on an electro-magnetically operated table). The period of consolidation on a vibrating-table is usually of the order of one to 1½ hours, depending chiefly on the average horizontal cross-sectional area of the mould, and the grading of the investment solids.

Slurry Composition

The secondary-investment slurry is composed of a carefully-compounded blend of refractory-particle sizes, and a liquid vehicle. The liquid may be nothing more than tap-water, or it may be a most expensive and highly temperamental formulation of chemicals containing liquids costing over 30s. per gal. When water alone is used, the bond is provided by one or other of the various types of hydraulic cement in the form of a powder mixed with the refractory aggregate. When a chemical-bonding liquid is used, the active agent is usually silica, in the form of a colloid precipitated from a hydrolized-ester solution or alkali/metal silicate solution.

With the chemical-bonding liquids of the latter types referred to, bonding or gelation is critically related to *p*H effects, and it has been found, in the Author's foundry, that it is not enough to achieve rigorous laboratory-type control and standardization of *p*H of the bonding liquid alone. The "reactivity," particularly of the super-fines fraction, of the refractory mix, has been found to exert a powerful effect on the variation of gelling times. Fig. 4 illustrates how one and the same secondary-investment refractory material exhibits varying degrees of chemical reactivity (indicated by *p*H changes of a standard acid solution) as a function of specific surface. Fully to appreciate the significance of this, we must bear in mind that the range of *p*H shift involved, corresponds to a decrease of "time to gel" period from many hours to a few seconds.

FIG. 6.—*Examples of two of the major metallurgical troubles that beset the investment caster: (Upper) hot-tearing in the radius at the junction of the cored boss and the baseplate, and (lower) slag spots, locally known also as "measles, spotted dick, pitting, and pock marking."*



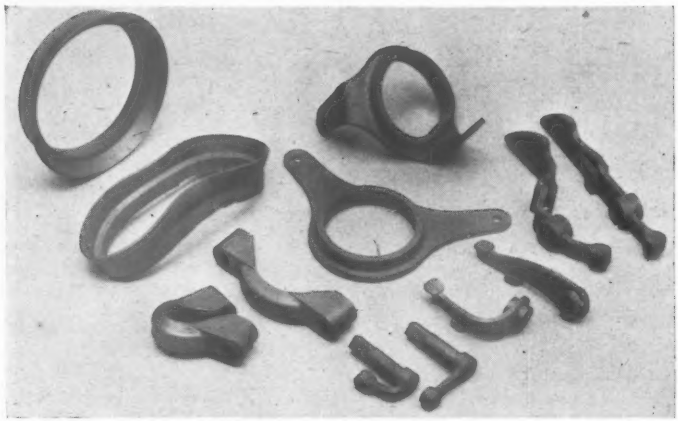


FIG. 7.—*Ductility of as-cast austenitic-stainless steels (HR, Crown Max., and F.V. 520) is shown in this photograph of various castings before and after receiving hammer blows.*

Since the investment process requires that the gelation period be not too early (*i.e.*, not before the investment slurry has had time to pack efficiently on the vibrating table); and not unduly prolonged, (*i.e.*, substantially completed before the de-waxing operation), it is essential that all the care taken to ensure uniformity of the chemical-bonding liquid (by titration and other laboratory operations) is not vitiated by wide random variations of specific surface of the fines fraction of the crushed fireclay or other refractory used. A further serious trouble which may be encountered when a high proportion of extremely fine refractory material is present is the uneconomically prolonged period required for consolidation of the investment on the vibrating table. This " fineness of the fines " fraction is only one of the many problems which may arise in connection with the lost-wax investing technique, which, if not fully understood and controlled, can give rise to serious trouble or even complete failure.

Mould Drying

After completion of consolidation of the refractory mass on the vibrating table, the excess liquid accumulated on the top of the mould is decanted, and the clamp-base and sheet of corrugated cardboard removed, the latter stripping readily from the wax feeder-head now firmly embedded in the mould. A gelation and air-drying period is then allowed, this being generally two to four days according to the size of the mould.

Depending on the particular technique being used, the mild-steel containers may be removed (facilitated by the vaselined brown-paper lining) prior to this drying period, *e.g.* cement-bonded moulds are usually strong enough to withstand wax-expansion stresses in the de-waxing oven without the aid of the reinforcing effect of the steel containers, hence the latter may be made available for re-use daily instead of being tied up for several days at a time.

De-waxing

De-waxing of the moulds is carried out in batch-type gas-fired ovens over a period of 8 to 12 hours, the maximum temperature reached at this stage being of the order of 90 deg. C. The molten wax, which flows out of the mould, is collected in trays, and later re-melted, cleaned and re-used for the production of runner-systems. An appreciable amount of wax, however, soaks through the dip-coat and into the body of the mould and is thus lost, having to be subsequently burnt out by combustion in an oxidizing atmosphere to remove the last traces of carbon residue.

Mould Firing

According to a casting-programme, the de-waxed moulds are fed in at the cool end of a 34-ft. long gas-fired tunnel furnace on refractory blocks (Fig. 5a). The whole train of 40 blocks, each carrying either two normal size moulds or one large one, is pushed towards the hot end by a compressed-air-driven ram, as and when required; the blocks leaving the hot end being transported by monorail back to the cool end for re-loading. Approximately half of the working length of the furnace has a temperature gradient up to the soaking temperature of 1,000 deg. C. in the remaining half. By the time the moulds reach the exit end (approximately 18 hours after loading), having travelled several yards at a bright red heat, all traces of wax, carbon residue, water and chemical vapours, etc., have been removed, and the moulds are then ready for casting.

Casting

In the majority of cases, the moulds are cast as taken straight from the soaking zone of the firing-off furnace, but in a number of cases, particularly the larger castings with thickish sections, a certain amount of mould cooling may be called for, prior to casting, to aid in achieving a greater measure of directional solidification. Gravity casting is carried out from both 5 and 10 lb. capacity indirect-arc furnaces, and from a 25 kw. radio-frequency furnace capable of melting up to approx. 25 lb. (Fig. 5*b*). Temperature control is effected by platinum-rhodium immersion pyrometer, the readings being recorded on circular charts. Casting temperatures for stainless and heat-resisting steels range from approximately 1,420 to 1,650 deg. C.

The casting operation, like the investing operation, can give rise to many troubles. In addition to casting temperature, there are several other

important factors which need careful attention to obtain successful results, *e.g.*, mould-cavity temperature; melting atmosphere, and speed of pouring. In one case where a difficult casting had to be fed through a double gate, from the feeder head, it was found essential to avoid too high a proportion of the metal being poured through one or other of the ingates, *viz:* to achieve the necessary soundness, the heat pick-up in the region of the ingates had to be balanced by ensuring that approximately equal quantities of metal flowed past the two sides of a core. Whilst no attempt can be made, in an article of this nature, to discuss this aspect of production fully, it would be inappropriate not to mention the two major troubles of a metallurgical nature encountered in lost-wax casting ferrous alloys. These are known by various names, *viz:* (*i*) Drawing, pulling, corner tearing, hot tearing, etc. (Fig. 6 upper), and (*ii*) measles, spotted-dick, slag spots, pitting, pock-marking, etc. (Fig. 6 lower).

When all has been done to alleviate these troubles, by changing the refractories and refractory bonds, mould temperatures, casting tempera-

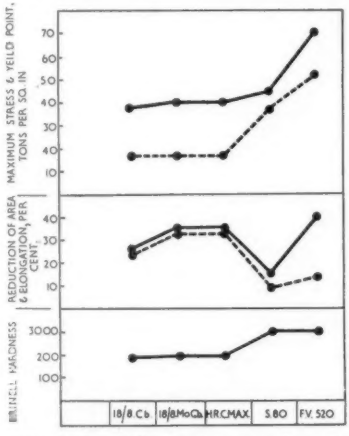


FIG. 8.—*Typical mechanical properties of various steels developed by Firth-Vickers for their investment-casting foundry.*

tures and the design of the casting, there is only one thing left to do; change the alloy!

Alloy Composition

The facts are that certain alloy compositions are remarkably favourable for the production of lost-wax castings, whereas others (sometimes essentially similar in composition), are most unfavourable, although still excellent for manufacture of bar and sheet, etc., from ingot form or castings made by other processes. One of the major tasks of the progressive investment foundry, is to develop favourable lost-wax casting-alloy compositions which, in addition to possessing the requisite castability, also provide the required mechanical properties, corrosion-resistance, weldability, etc., and then establish agreement with the would-be user to accept these in lieu of standard specifications applicable only to forgings, stampings, sand-castings, etc. It is very gratifying to note that the British Standards Institution has now taken up, with industry, the subject of standard specifications applicable to investment castings composition alloy.

Fettling

After casting, most of the mould material is removed from the cast assembly and the latter cut up to separate the runners, feeder-head, etc., from the casting or castings. These operations are referred to as "knock-out" and "parting off." At this stage, a fracture test-piece also cast-on on the assembly is subjected to a hardness check and a bend test.

After shotblasting and preliminary inspection, the castings are then fettled, this operation mainly consisting of grinding and/or linishing the piece or pieces of excess-runner metal left on at the parting-off stage. The castings are then given a final shot-blast, all over, for further visual inspection.

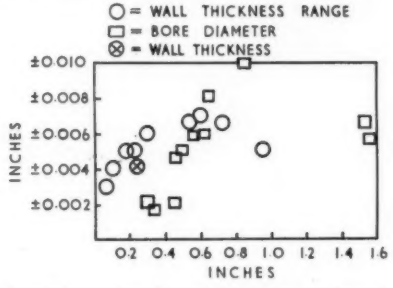


FIG. 9.—*Dimensional variations as a function of magnitude of bore and section thickness on a random selection of austenitic castings.*

Other Operations

According to varying requirements, one or more of the following steps may be carried out prior to despatch; heat-treatment; acid etching; dye-penetrant testing; pressure-testing, Zyglo examination; magna-flux testing and 100 per cent. X-ray examination.

Having described a typical manufacturing process in some detail, the major aspects of the results achieved can be considered under the following headings: mechanical and other properties; dimensional reproduction; scope of the process; economics, and technical achievements.

Mechanical Properties

Although for many years it has been no longer true, there still lingers in the minds of many, the idea that all cast objects are brittle, or at least a poor risk, this arising, of course, from the familiar brittle fracture of many cast-iron objects. Paradoxically, investment castings, as a class, in spite of being cast into exceptionally hot moulds, provide what is probably the most impressive evidence to

FIG. 10.—*Range of products of the precision investment foundry at Firth-Vickers, including aircraft-mechanism levers, valve and mixing parts for the chemical and dairy industries, gas and other fuel nozzles, aircraft hydraulic-system components, camera parts, glass-handling equipment levers, scientific-instrument parts, chemical filtering components, etc.*

the contrary. In the field of ferrous investment casting, it is almost certainly true that the majority are cast in the austenitic stainless type of alloy, and it is this type in particular which exhibits remarkable ductility in the cast-condition. Fig. 7 shows a small selection of aircraft parts in H.R. Crown Max and FV.520 before and after receiving hammer blows.

Fig. 8 graphically illustrates typical mechanical properties of the chief stainless and heat-resisting alloys developed by Firth-Vickers and adapted for investment casting. The service requirements of an investment casting may be classified along the following lines:

(*a*) Stainless properties, mechanical properties of minor importance; (*b*) stainless properties and abrasion-resistance, other properties unimportant; (*c*) abrasion resistance and moderately good mechanical properties, stainless properties not important; (*d*) high mechanical properties, stainless properties not essential, and (*e*) high mechanical properties, corrosion-resistance and weldability required.

Until recently, it would have been a fair generalization to say, that in order to get high mechanical properties one would have to forego stainless properties and good weldability, and conversely, to get good corrosion-resistance and weldability, one would have to accept moderate or poor mechanical properties. Now, however, due to the development of FV.520 steel, the designer can have all three. Further, the steels with excellent corrosion and heat resistance are generally excellent for investment casting, whereas the non-stainless, high-mechanical-property alloys are generally unfavourable.

Dimensional Reproduction

Time after time, the investment founder is asked the unanswerable questions: "How close can you cast?"; "What limits can you cast to?". Unfortunately, there is no equally short and simple answer to these questions. Each case has to be fully considered with respect to shape, section-thicknesses, steel quality, etc., before even a general tolerance level may be quoted.

Shortly after the second world war, much unhelpful "overselling" of the process occurred by the

oft-repeated quotation of its capability to cast to ± 0.001-in. without context. However, having raised this subject, it is not proposed to dodge the issue. Fig. 9 indicates the ranges of dimensional variation as a function of magnitude of bores and solid dimensions met with, on a random selection of typical austenitic investment-cast parts made by the company. To appraise fully the significance of the plotted points, it is necessary to bear in mind that these points indicate the range covered by 95 per cent. or more of the " population " measured at each size level and since the distributions are chiefly Gaussian or Skew types, by far the majority of the readings fall within much smaller ranges, *e.g.* whereas in a particular case 100 readings covered a range of 0.008 from 0.258 to 0.265-in., the inner 75 per cent. covered a range of only 0.003-in. *i.e.* ± 0.001-in. about the mean.

Range of Products

Fig. 10 illustrates the character of the output of Firth-Vickers precision foundry, among the components are aircraft-mechanism levers; valve and mixing parts for the chemical and dairy industries; gas and other fuel nozzles; aircraft hydraulic system components; camera parts; glass-handling equipment levers; scientific-instrument parts; chemical filtering components, etc. Typical of the smallest castings is a special washer 0.6-in. dia. with a cross-section of 0.050 by 0.10 in. requiring 377 to the lb. (0.042 oz.). Typical of the larger castings is a filter-frame eyelet weighing 3 lb., roughly 4 by 5-in. with a maximum cross-section of 2 by $\frac{3}{4}$-in. A valve plunger $6\frac{1}{2}$-in. long by various diameters up to $1\frac{1}{8}$-in. weighing 1.1 lb. is another example. These cases are, however, in the nature of extremes, and it should be emphasized that the legitimate range of lost-wax castings (*i.e.* ignoring certain notable exceptions achieved by recent developments) covers weights from a fraction of an ounce up to say 7 ounces, with section thicknesses generally not greater than $\frac{1}{8}$-in.

Economics

Much nonsense has been spoken and written about the high cost per lb. of lost-wax castings. The word high in this context definitely implies relativity—relative to what?—if it means relative to other forms of casting production, it is even more nonsensical than if it meant relative to machining from stock. The fundamental facts are these:

(*a*) More than in any other casting process, a precision-investment casting represents workmanship rather than metal, the cost of the alloy being almost incidental in a high proportion of cases.

(*b*) The weight of a precision-investment casting is only indirectly related to its cost of production.

(*c*) The return that the purchaser, of a legitimate precision-investment casting, gets for his money is largely the intangible (certainly imponderable!) value of the considerable time and expense saved on either simple or complex machining or other operations.

(*d*) It is the shape of the component that determines, to a very large extent, the cost of production as an investment casting, and this is in no way necessarily related to the cost to produce by alternative methods (*e.g.* entirely by machining); for instance, it is by no means uncommon for a part of a certain weight that is relatively easy to produce as an investment casting being of such a shape that it is excessively costly to obtain by machining, whereas another component of the same weight may be of such a shape that whilst it is still economic to manufacture from an investment casting, the machining expense is not excessive but the geometry and/or problems involved in investment casting the part raise the casting cost above that of the part costing more to machine.

A study of Fig. 11 will help to clarify the function of the shape-factor as it affects the weight: manufacturing-cost relationship. This graph shows the band or curve representing hundreds of manufacturing costs per lb., as a function of casting weight, which may arbitrarily be divided into three zones identified as follows: (*a*) Very-low weights; cost per lb. extremely sensitive to changes in weight; (*b*) Very-high weights; relatively narrow width of band, *i.e.* relatively little variation in cost per lb., at the same weight level, and (*c*) Intermediate-weight range; characterized by a wide band which may embrace several 100 per cent. variation in cost per lb. at a particular weight level. It can thus be seen, (*a*) and (*b*) that below and above a certain weight range, shape becomes of less and less importance. Once the weight, and hence the size of the casting, has reached a very low level the handling or production treatment of such becomes more or less uniform, *i.e.* virtually identical for all cases, hence shape loses its significance. However, as can be seen from the asymptotic nature of the curve, at low weights, some other factor or factors are exerting extremely powerful effects to raise the cost per lb. to astronomical heights. The explanation for this is

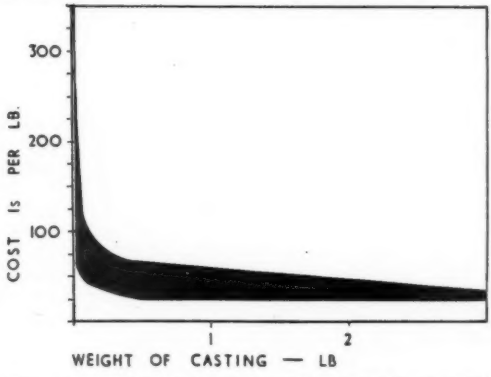


FIG. 11.—*Relationship of casting weight to total cost, measured as* 1*s. per lb.*

not far to seek; as the size of the castings gets more and more minute, the greater the ratio of investment and steel, etc., to castings volume, till by the time the castings have nil weight, size and volume, the

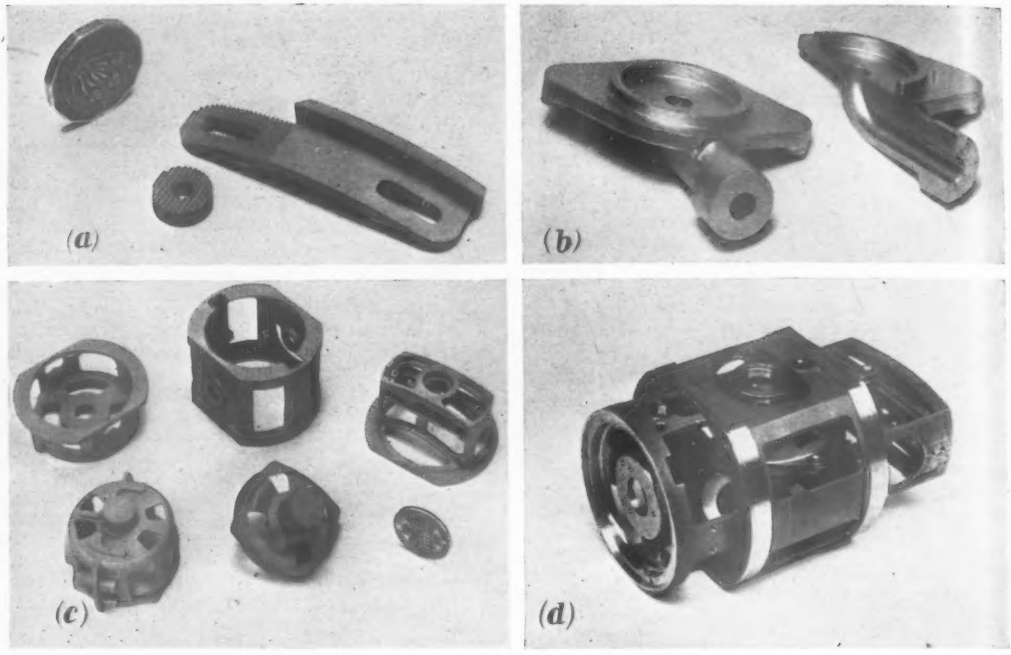


FIG. 12.—*Products in the range of lost-wax castings produced by Firth-Vickers: (a) Serrated slide and washer compared with a threepenny-piece; (b) high-pressure fuel-flange casting (shown also in section, illustrating the as-cast curved bore not obtainable by machining); (c) five separately cast components of an aircraft gyroscope, and (d) the finish-machined components of the gyroscope in the arrangement of final assembly.*

whole operations are a dead loss, and the cost of the non-existent castings is infinite.

Above a casting weight of about 2¾ lb., the 1s. per lb. becomes more or less constant (*i.e.* manufacturing cost is more or less proportional to casting weight), although it is obvious that generally the cast sections will be much thicker and shapes far less complex. This can be interpreted to mean that above the normal legitimate range of investment-casting weights, the hitherto highly-prominent factor of workmanship becomes (as with very small sizes) virtually constant, but of relatively less importance to the value of the metal sold per casting.

The weight range from 0.01 to 2¾ lb. includes all legitimate investment work and, as can be seen from the graph, a wide variation in manufacturing cost per lb. is encountered at all weight levels. This is due to the effects on manufacturing costs of the almost infinite variety of shapes called for, any one or more of the various production operations being liable to be adversely or favourably affected by shape characteristics.

Technical Achievements

As stated earlier, there are cases where lost-wax investment casting is called for on purely technical grounds, *i.e.* all question of economics apart, the production of the components in question can be seriously entertained only as investment castings. These cases in particular, also show, along with many others, phenomenal savings in production costs and time. Further examples of the Company's range of investment castings are shown in Fig. 12, these indicating the considerable scope of the process and the complexity of design that can be achieved.

Conclusion

A necessarily restricted account has been given of one of the foundries of Firth-Vickers Stainless Steels, Limited, against an outline of the technically complex processes involved. The precision-investment foundry, is, however, only one of the several foundries operated, the others producing both static, centri-sand and centri-die castings.

Acknowledgments

The author wishes to thank the directors of Firth-Vickers Stainless Steels, Limited, for permission to publish this Paper.

European Mechanical Handling Federation

The fifth European congress of the *Fedération Européenne de la Manutention* (European Mechanical Handling Federation) was held in Vienna on October 9 and 10; the Austrian national committee were the hosts and there were present delegates from Austria, Belgium, Denmark, France, Germany, Great Britain, Sweden, and Switzerland. At a meeting of section II of the Federation dealing with continuous conveying the programme of work embarked upon at the July meeting in Zurich was continued and the tasks involved were distributed among three working groups to study matters pertaining to nomenclature and terminology, technical relations with users and suppliers, standardization, etc. The sub-committee on nomenclature completed the first stage of their work which was a glossary of technical terms, in seven languages, of various types of conveying units. The nomenclature and sketches were, subject to certain minor modifications, completed ready for printing and will form part of the comprehensive dictionary of material-handling plant which is being undertaken by the Federation as a body.

Considerable progress was also made by the group charged with the duty of devising proposed European Standards for troughed belt conveyor idlers and for rollers for gravity conveyors, and as the result of their study of certain existing national standards it is expected that a common formula will be achieved at their next meeting. The work of the third working group was mainly centred on the question of general conditions of contract, and a study is to be made by the various groups on a national level of the UNO conditions for the supply and erection for export (1957) in an effort to ascertain whether these are capable of being generally adopted by the section. At the close of the first session of the meeting of the full section a lecture on "Vibrating Conveyor Techniques" was presented by Mr. H. Sernetz.

The office bearers of the section were elected as follows:— Chairman: Mr. T. A. Hammersley, Marco Conveyor & Engineering Company, Limited (Great Britain); vice-chairmen: Mr. W. Hamman (Austria), and Mr. E. Borthen (Sweden).

Foreign Economic Reports

The following extracts have been prepared from recent economic reports emanating from the Export Services Branch of the Board of Trade. In each case an attempt is made to include mention of trends which may influence founding business.

Columbia: The Columbia Metallurgical Federation has petitioned the superintendent of Importations to transfer, to the prohibited or licensed lists, certain products, imports of which threaten native production. It is interesting to note that castings are not specified at present. Production of gold and silver, during the first five months of 1957 were 151,083, and 47,196 troy ounces, respectively.

Denmark: Industrial circles are stated to be apprehensive of their prospects under both the European Economic Community, and the Free Trade Area schemes. Mr. A. Rytter, chairman of the Industrial Council, stated that Denmark could not fail to join one or the other. Burmeister & Wain have contracted to build what is claimed will be the largest two-stroke supercharged 12-cylinder diesel engine, with a capacity of 22,000 h.p.

Libya: The economy of the country has been buoyant during the first half of 1957, despite the effects of the Suez crisis which, fortunately, have been short-lived. UK exports of coal and coke fell by £L625,000 to £L98,000 during the period January to June; however, increases in other commodity exports (metal manufactures £L51,000, iron and steel £L99,000) have maintained the overall improvement in export figures from this country to Libya.

Portuguese West Africa: Exports of manganese were maintained at about the 1956 figures (£207,550 for the period April to August). Permission has been sought to erect a ceramics factory in Luanda, and according to Press reports, a plan is being considered for the erection of an electrical components factory.

Tribute to Foundrymen

When 10 Staffordshire men decided at Birmingham Assizes not to press an action for damages against their firm, Mr. Justice Stable said: "If I may say so with pride, I thought they were the finest body of English working men that I have ever seen in a court of law, and I am very proud to belong to the same nation."

The men, together with the widow of an eleventh employee, had claimed damages from John Harper & Company, Limited, general ironfounders and makers of gas and oil appliances, of Willenhall (Staffs), alleging negligence in not providing the means to prevent them inhaling silica dust. All had contracted pneumoconiosis and had been granted disability pensions ranging from 10 per cent. to 100 per cent.

When the plaintiffs' case, which had occupied eight days, ended, their counsel, Mr. Richard Elwes, QC, announced that they did not wish to press the action. He said that having heard the evidence and arguments they thought it wrong to continue to press an allegation, which now turned out to be unfounded, against employers who had always treated them well.

Entering judgment for the company, with costs, Mr. Justice Stable, who had visited the factory during the hearing, said: "In my experience as a judge, which now goes back for nearly 20 years, I have never tried a case in which, throughout, I was more impressed by the admirable relations between the management and the men."

Between them the plaintiffs had 309 years' service with the company. They were:—Edwin Betteridge (55), Edward Betteridge (46), Wilfred Brown (52), Wilfred Hodgkiss (55), Alfred John Smith (53), William Tomlinson (48), Daniel Tranter (53), William Wooley (54), Albert Harris (42), and Herbert Smith (59). Mrs. Nancy Martha White, widow of Samuel White, who died in 1954 after 20 years with the firm, also claimed damages. A twelfth plaintiff, Albert Joseph Davies, died after the action was begun.

Machinery Imports from the Dollar Area

Modification in the arrangements for the grant of import licences for machinery from the dollar area is announced by the Board of Trade. Applicants will no longer be asked to indicate whether an alternative machine is obtainable from non-dollar sources outside the United Kingdom. There will be no change in the present requirements that the dollar machine must reduce costs and that no alternative UK machine offering roughly similar advantages is available. The present rules for the licensing of dollar machinery have operated since mid-1954.

Book Review

Bibliography of Papers Relative to Foundry Defects. (Compiled from material submitted to the International Committee on Foundry Defects by the *Centre Technique des Industries de la Fonderie.*) Published by the *Association Technique de Fonderie* and obtainable from the Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, 3; price 35s.

This mimeographed publication runs to 556 pages and is divided into five sections. Within this compass, there are listed papers which have appeared in the foundry Press of the world and which bear upon the question of defects in castings. Thus, only those either possessing or having access to a well-stocked library of foundry literature, will be able to derive maximum benefit from this publication. Though the book is printed in French, there should be little difficulty in appreciating the references, as at the beginning of each section all the titles are translated into English and German. The reviewer deems this to be adequate, as personal contact with foundry executives of many nationalities has shown that they can "manage" in the three languages used in this bibliography. It should be clearly understood that this collected work confines itself to setting out sources of information, and contains no direct indications of cures for the defects described. For firms which are members of the national foundry research associations, all of which possess excellent reference libraries, the book can be of real value when a search is being made for documentary information about a persistent foundry defect.

Publications Received

Bulletin of the British Cast Iron Research Association, Vol. 15, No. 2. Published by the Association from Alvechurch, Birmingham.

This issue appropriately contains an interesting article by Mr. G. R. Woodward on Thomas Telford, F.R.S., as 1957 is the bicentenary of his birth. Telford was amongst the first engineers to test the mechanical properties of cast iron, then the normal material for civil-engineering work. This issue also contains a bibliography on industrial noise, with special reference to the foundry. Nineteen sources of information are listed, but a quite important item which was published by *Gray Iron News* has not been included. It gave the results of experiments on noise reduction carried out in an American foundry. The balance of this *Bulletin* is given over, as usual, to the very fine abstracts the Association makes from the foundry literature of the world.

Electrostatic Precipitation, 11th Edition. Published by the Sturtevant Engineering Company, Limited, Southern House, Cannon Street, London, E.C.4.

For an industrial publication to reach eleven editions is indeed a high commendation as to its worth. Much of this publication is devoted to technical matter and records the high efficiency of electrostatic precipitators. It is shown how design must be varied to attain maximum efficiency with the various types of effluent gases. Some carrying SO_2, CO_2 and CO are easier to handle than when these compounds are absent. Included in the book are a number of photomicrographs which well indicate the diverse character of industrial dust-carrying gases. This booklet is an excellent example of high-grade industrial publicity.

International Alloys, Limited, 1932 to 1957. Issued from Haydon Hill, Aylesbury, Bucks.

In connection with their Silver Jubilee (upon which warm congratulations are offered from the staff of this JOURNAL), International Alloys, Limited, have published a beautifully illustrated brochure which outlines the history of the concern, illustrates the facilities they have for handling light-alloy scrap, ingots and billets, and the nature of the controls they impose. Finally, a glimpse is given of the firm's welfare activities. By way of an appendix, well-documented data sheets have been included.

Facts and Figures about British Railways, 1957 Edition. Published by the British Transport Commission, 222, Marylebone Road, London, N.W.1.

The possession of a few shares in a public company by a person usually ensures his careful scrutiny of that company's annual statement of accounts. Thus, as everyone is now a shareholder in British Railways its annual report is equally worthy of close attention. Moreover, it makes much more interesting reading than the average commercial or industrial company's report. Anyone can obtain a copy of it by writing to Marylebone Road.

New Catalogues

Light Filters. A 12-page booklet on this subject from Kodak, Limited, Kingsway, London, W.C.2, is distinctly utilitarian and of direct application to works photography and photomicrography. When the present writer once approached a man taking a photograph on a misty evening with the query, "Surely the conditions are such that your film will be wasted?," he was told "It all depends on the filter!"—and so it transpired, as a perfect picture resulted. Later experience has shown that this applies to all photography, and that to get optimum results filters must be used intelligently. In this catalogue over 60 different Wratten filters are listed and their purposes described, eight of them being specially suited to photomicrography. Other information in the booklet includes notes on the employment of filters, the forms in which they are available, how to order, special combinations, a number of recommendations, and a list of sources of additional data.

Foundry Plant. Metals & Equipment (W'ton), Limited, Tudor House, Broad Street, Wolverhampton, have published a catalogue covering the well-known range of Zimmermann moulding machines; Vogel and Schemann coreshooters, shot-blast plant, sand mixers and cupolas, and foundry sundries. The coreshooters are claimed to be well suited for use with the CO_2 Process. Apparently this is a general catalogue and others, more comprehensive, are available covering the various items shown.

Stainless-steel Fittings. Two folders have been received from the Talbot Stead Tube Company, Limited, Green Lane, Walsall. The first describes and illustrates the Cupford valve, which is used in food, brewing and dairy industries and would appear to be basically a casting. The second covers stainless-steel fittings, which are made to form the connections to the tubing in which the firm specializes. They carry the brand mark Metior.

Excavators. Those readers who operate sand quarries will be interested in publication No. 4/442 issued by Ransomes & Rapier, Limited, Waterside Works, Ipswich. Whilst some of the plant described and illustrated is on the large size, there are models with from 2½ to 4 cub. yd. shovel capacity.

Three Foundries in the Irish Republic

By V. C. Faulkner F.R.S.A.

During a recent visit to the Irish Republic, the writer was received by three foundries which rank amongst the most important ones. Because of the protective tariff on imported castings for builders' and municipal castings, all have departments catering for this class of goods.

Hammond Lane Foundry

The Hammond Lane Foundry Company, Limited, is a holding company and the foundry is a subsidiary concern called Hammond Lane Ironfounders, Limited. The parent company ranks amongst the largest manufacturing concerns in the Irish Republic and the group employs about 1,000 people. It is a very progressive concern. It operates an important sheet-metal department and has important export trade to this country, Malta and New Zealand for a line of tinned milk-cans. Industrial Gases (IFS), Limited, another subsidiary of which Mr. S. W. Aitkin is managing director, is at present erecting a new factory in the outskirts of Dublin. Another subsidiary company is Western Iron Company, Limited, at Sligo, which also makes rainwater goods.

The Hammond Lane concern was founded about 50 years ago by the father of the present chairman, Mr. D. Frame. He was an iron and steel merchant and bought the foundry for scrapping, but the moulders requested him to continue the business and good success has been achieved. Shipbreaking and scrap handling is still a very important section of the group's activities.

The foundry is managed by Mr. J. Graham, who hails from Falkirk. The shops which are particularly tidy employ between 300 and 350 men. The normal run of orders is deemed to be insufficient to warrant a completely mechanized plant and the system of a moulder having an area allotted to him and carrying his pattern from mould to mould is practised. However, when a large repetition order is received, there is a self-contained unit by Bonvillain and Ronceray for sand preparation serving a pair of machines made by the British Moulding Machine Company, Limited. Melting is carried out in a pair of cupolas supplied by Constructional Engineering Company, Limited. Internal transport is largely effected by Lister trucks.

The fettling shop is very interesting as the management being unable to buy—during the war—shotblast equipment and stand grinders, made their own. The former, of which there are two, are of the rotary-table type and are obviously working satisfactorily. The grinders are of a simple design and are built up of four castings.

As the firm makes lines of cooking stoves, a vitreous enamelling department is operated. The ovens have been supplied by Ferro Enamels, Limited, and are of the batch type. Because quantity is insufficient, the assembly of the cookers is carried out on a series of jigs, so contrived that handling is much simplified. Great importance is attached to the fitting of the doors and the testing is effected by systematically inserting a piece of paper in every position of closing. The pattern-shop, which has a staff of eight, does a quantity of plaster work as is customary in the light iron castings trade.

Though the law does not require foundry concerns to provide bathing facilities, the management of Hammond Lane have an excellent department in operation. It is used quite extensively by the operatives, especially on Friday nights. Whilst so far no canteen has been provided, a rest room has been placed at the disposal of the men, where meals can be taken in comfort. There is a very complete coverage of sporting activities in the Hammond Lane Group—football, golf, tennis, dancing, etc., being catered for. The writer expresses his thanks to Mr. Frame and Mr. Graham for the courteous reception accorded to him.

I.V.I. Foundry, Limited

The I.V.I. Foundry is a well-conducted concern situated at Athy in County Kildare, some 40 miles south of Dublin. It is owned by Col. H. J. Hosie, O.B.E., M.I.MECH.E., who is animated by the sentiment that there is room for one really good jobbing foundry in the Irish Republic and he means to have it. He has a staff of about 150 and all are quite young men. Only a part of the foundry is given over to rainwater goods, and the major portion is devoted to jobbing work for the brewing, paper-making, peat-lifting, electricity-generating and steelmaking industries. For the last industry, a line of ingot moulds is being made, for the cores of which and indeed for the major part of the production, the CO_2 process is being used to advantage. The foundry floor has been concreted and has a neat and tidy aspect. The foundry operates a small machine shop, so that customers' castings can be semi-finished before delivery. Though the foundry is quite near to the railway, preference is given to road transport. Most of the raw materials are imported through Dublin, but the sand is fetched from Belfast. There is a good supply of wind-blown dune sand available and the future may see the Southern Irish foundries turn over to synthetic sands, as is the case in other countries where no natural moulding sand deposits are available locally. The five tons of metal which is cast up daily is melted in two cupolas—used on alternate days—and installed by the Constructional

Three Foundries in the Irish Republic

Engineering Company, Limited. A cupolette is available and this could be used for making some of the high-duty irons now being made, as for instance, a line of crusher plates for the paper-making industry. This production has been particularly successful as they are giving twice the life of those supplied from Scandinavia. The firm is a member of the British Cast Iron Research Association and is appreciative of the great help given to them by its officers.

The company operates a small, but efficient, patternshop which, like the rest of the concern (including the office staff) is accorded a production bonus. Colonel Hosie has promised to give readers the benefit of his efforts in this direction, for it is acknowledged to be a difficult task to do this equitably.

Plans have been prepared for the provision of bathing and washing facilities and for a canteen. The firm is still short of workpeople as emigration takes a heavy toll. Indeed, Colonel Hosie showed the writer a quite extensive row of terrace houses occupied by "grass widows," the husbands all being overseas.

New properly dust-extracted plant is being installed in the fettling shops, where at the moment much work is finished by rotating dust-exhausted barrels. The writer's warm thanks are due to Colonel Hosie for showing us his interesting foundry and for many personal courtesies.

Tonge and Taggert, Limited

The writer spent a very interesting morning with Mr. Tonge, the managing director of Tonge and Taggert, Limited. The firm operates a large foundry at Windmill Lane, Sir John Rogerson's Quay, Dublin, where in addition to jobbing work, quantities of various types of municipal and builders' castings are made. At a separate foundry, associated with the Stanton Ironworks Company, Limited, a semi-mechanized foundry situated at East Wall, Dublin, turns out large quantities of water-main pipe-specials, surface boxes, manhole-covers, etc. Whilst this concern has not yet installed showers or bathing facilities for the men, it does operate canteens. There has been a distinct falling off in the demand for builders' castings this year, consequent upon the slowing up of the construction of housing estates. Apart from this lull, employment has been steady for the last ten years. Mr. Tonge's foundry manager, Mr. J. H. Witham, regularly participates in foundry technical conferences and was a member of a productivity team which visited the United States. Very unfortunately, time did not permit the writer to tour the works, which is known to be both well equipped and intelligently organized.

Bright Pickling of Brass

The French journal *Fonderie* has given the following reply to a correspondent who raised the question as to how to produce a good surface finish on 60/40 brass castings, carrying 1.5 per cent. of lead. The reply given was based on a number of actual laboratory tests. During the course of these tests, using six types of pickling bath, the best results, so far as surface lustre was concerned, were obtained under the following conditions:—

Chemical composition of the bath:	
Sulphuric acid (SG 1.83)	400 ml.
Nitric acid (SG 1.38)	100 ml.
Hydrochloric acid (SG 1.19)	5 ml.
Chromium trioxide (CrO_3)	55 to 60 gm.
Water	1,000 ml.

The process was carried out at room temperature and treatment lasted 2 to 3 min.

Inhibition

After rinsing the castings in cold running water, there may remain on the surface a light powdery deposit, but this can be easily removed by wiping. Beyond the surface lustre given to the alloy, a certain advantage accrues during machining from the absence of the nitrous fumes normally found after treatment of castings in nitro-sulphuric acid mixtures. The presence of chromium trioxide appears to have some effect in this direction and materially reduces the speed of reaction, so avoiding a too violent attack on the alloy.

Russians praise UK Electricity Schemes

A delegation of eight Russian electrical engineers, who have just completed a tour of Scottish hydro-electric sites, had qualified praise for the installations when they gave a Press conference on October 17. Mr. F. G. Loginov, chief deputy of the Ministry of Electric Power Stations in the Soviet Union, said that the visit had confirmed the high standard of British design.

Britain was in advance of the USSR in the development of hydro-electric resources. "You have exploited 30 per cent. of your hydro-electric potential; we have touched only 2 per cent. of ours," he said. "But you must bear in mind that 2 per cent. represents 7,000,000 kw. installed capacity."

Mr. Loginov went on to say that the delegation had been impressed by what they had seen during their visits to John Brown & Company (Clydebank), Limited, the Metropolitan-Vickers Electrical Company, Limited, Manchester, the DSIR mechanical engineering laboratory, East Kilbride, and other manufacturing plants and laboratories. They had been particularly interested in tunnelling methods in Scotland.

British equipment was well known and had a good reputation in the USSR and, if British manufacturers could be invited to supply goods, the Russian electricity industry's output could be increased. But because some countries were "in agreement with the US to limit exports to the People's Republics and the USSR," this could not be done.

NORTH EASTERN MARINE ENGINEERING COMPANY, LIMITED—Mr. J. A. Smith and Mr. H. C. McIntyre have been appointed commercial director and works director, respectively. Mr. Smith was formerly chief accountant, and Mr. McIntyre, works manager.

UNITED CONSTRUCTION MACHINERY COMPANY, LIMITED—Mr. W. R. R. Husser has joined the board.

DUNLOP RUBBER COMPANY, LIMITED—Mr. T. E. Peppercorn, director of oversea sales, has joined the board.

Hints for Teachers of Craft Subjects

*By C. B. Fearnside**

It is a well-known fact that whilst a thorough knowledge of his subject is very important, it is by no means the sole qualification for the making of a successful teacher or instructor. Many problems face a craftsman when he is asked to impart his knowledge to a class of students and hours spent in studying for and preparation of lectures must sometimes appear to have been wasted, when it is realized later how little of a lesson has been understood and learned by students. With this in mind, it is hoped that the following suggestions, whilst yet only touching the fringe of the problem, may be of some assistance to craft teachers.

Planning

For subject-matter and depth of treatment when teaching craft subjects, such as foundrywork and patternmaking, reference can be made to the syllabuses prepared by the City and Guilds of London Institute, the Union of Lancashire and Cheshire Institutes, Northern Counties Technical Examinations Council and other similar organizations and also the booklet "Specimen Notes for Teachers" published by the Institute of British Foundrymen. It cannot be over-emphasized that every lesson requires careful pre-planning if it is to be a success. In some cases, this preparation may take only a few minutes, whilst other lessons will require considerable time and forethought. A good instructor, going over similar ground with each new batch of students, will review his notes every time, as it is only after a lesson has been "put over" once or twice that flaws and shortcomings become apparent. It is said that a famous Yorkshire cricketer of pre-war days accounted partly for the success of his side by having a little book in which he kept particulars of the points and weaknesses of leading players in other teams. The teacher who has a note of the points which his students readily learn and those which they find difficult to understand, can so regulate his instruction as to give ample time for trying various methods of making the difficult points understandable.

Layout and "Breakdown" of Instruction Schemes

Many advantages are to be gained by laying out lessons on programme sheets under the following typical headings: Title; main points to be developed; relevant subsidiary information; apparatus or models to be introduced; homework; and recommended reading. These schemes of work help in making the instruction progressive—building each lesson on that which has gone before—and with the layouts before him, a teacher is unlikely to miss out an important point or digress on to irrelevant subjects.

Whilst it may be necessary for the students to be supplied with notes on the subject of the lesson, it is generally advisable to allocate some of the time for actual teaching. It is obvious that the greater a student's interest in a subject, the more likely he is to learn about it and—more important—to retain the knowledge gained. However, to maintain the attention and concentration of a class for a period of 2 to 2½ hours is no easy matter, so that to avoid flagging of interest such a period of instruction must be broken down. A well-tried and effective method is to start a lesson by asking a few questions regarding the previous work done and, by judicious inquiry, gradually bring the answers to the subject for the current lesson.

The formulation of suitable questions requires practice, and it is important that a question be posed *before* indicating the person who is required to answer it; care should always be taken not to embarrass a student or keep him on tenterhooks as to what form a question is going to take. As the lesson proceeds and the main points are brought out, models, specimens and so on, which until then have been kept out of sight, should be produced to illustrate the text, to add emphasis and assist in maintaining interest and attention.

Taking Notes

When it is felt that students have been given sufficient to digest for the present, or if interest appears to be flagging, then is the time to allow notes to be taken from dictation or duplicated copies. If these notes are to be of real value to the student, they must be compiled very carefully, bearing in mind one or two important facets. The average student entering a technical college has rarely had the training necessary to enable him to read several pages from a textbook and extract the main items from a mass of information. He probably has neither the aptitude nor the time to spend hours wading through pages of what, to him, may be rather dull stuff. It is therefore up to the teacher to give him notes in a form and at a level of complexity to which he is accustomed, from which he can readily assimilate the main facts and relevant points.

The presentation of the news in the Press gives an indication of the kind of thing required, *i.e.* a title which almost tells the story in itself, smaller headings giving the chief points of interest and a few short sentences to supply the relevant facts. Voluminous notes taken practically word for word from a textbook are of little value to a craft apprentice.

Further Study

Provision should be made in the layout of lessons for the keen student to obtain further detailed information from textbooks, trade journals, manufacturers' literature and the like. Homework can play an important part in the learning process and in the preparation for examinations, but questions must be chosen and worded with great care.

* The Author is lecturer in foundrywork and patternmaking at the School of Engineering, Burnbank, Lanarkshire.

Hints for Teachers of Craft Subjects

Answers should be marked by the teacher who set the exercises; only he is really fitted to criticize and suggest improvements in the answers in the light of the syllabus covered. An occasional impromptu short test is of value to both teacher and student; the results show the former whether or not his teaching is successful and will indicate weaknesses and shortcomings to the latter. Furthermore, a test of this kind, representing as it does a sort of challenge, serves to keep students "on their toes."

The manner of presentation of a single lesson or a year's work in a study of foundrywork, as indeed in all other cases, depends on many factors, not least the age and ability of the class members. However, it is believed that, if followed, the themes suggested will go some considerable way towards increasing enthusiasm, interest and ultimate knowledge among students.

Rise in Iron and Steel Production

With the end of the holiday period steel production rose in September to a weekly average of 438,200 tons, compared with 417,000 tons in September, 1956. This is, however, still 5,000 tons below the pre-holiday peak of 443,200 tons, recorded in May.

Pig-iron production in September was at the rate of 282,700 tons, 30,200 tons more than a year ago, and an increase of about 12 per cent., compared with a 10 per cent. increase for the month of August.

Comparative Tonnage of Iron and Steel Production

Period.	Pig-iron.		Steel ingots and castings.	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
1957—July	263,400	13,695,000	362,500	18,848,000
August ..	272,500	14,169,000	373,400	19,417,000
September ..	282,700	14,698,000	438,200	22,789,000
First 9 months	272,500	14,169,000	415,400	21,602,000
1956—July	240,300	12,498,000	326,400	16,971,000
August ..	235,900	12,265,000	340,600	17,712,000
September ..	252,500	13,131,000	417,000	21,686,000
First 9 months	250,400	13,022,000	391,700	20,366,000

Avro Gains Control of Dosco

Control of about 76 per cent. of the outstanding common stock and debentures of the Dominion Steel & Coal Corporation, Limited, has been secured by A. V. Roe (Canada), Limited. It was announced on October 10 that the company had gained control of 2,228,817 common shares, or their equivalent in debenture bonds.

This is one of Canada's largest industrial mergers and unites the Dominion's largest aircraft manufacturer with the country's largest coal producer. It is expected that it will cost Avro about £35,000,000. Dosco is Canada's fourth largest producer of steel.

Major opposition to the merger collapsed finally when Mr. R. A. Jodrey, a Dosco director, announced that he had failed to obtain the support of the 25 per cent. of the Dosco shareholders required to force a special meeting to dispute the deal.

Brass and Brasses

Historical Origins Discussed

Brass is an alloy mainly of copper and zinc. The word was once applied to what is now called bronze—that alloy of copper and tin. The brass of the Bible references was almost certainly bronze and so was much of the metal so described in mediæval times until the differences between tin and zinc came to be understood. It seems that the Romans made brass by melting together copper and *cadmia* which is one of the zinc ores.

By the end of the 16th century the making of brass was well established in this country although sheet brass for such things as monumental brasses on tombs had to be imported into Britain from the Continent up until 1649. That year a German established a manufactory for sheet-brass at Esher. Ordinary brass castings, under a patent granted by Queen Elizabeth I, were made by William Humfrey and Christopher Shutz who were thus given a monopoly "to work calamine" (the English ore of zinc) and to make brass. The patent later became the prerogative of the "Governors, Assistants and Societies of the City of London of and for the Mineral and Battery Works" and this continued until the year 1710. Evidently brass cannon were cast—at least in the smaller sizes of ordnance—although it was a bronze mixture that was usually most popular and had been cast in England since about 1521 (Henry VIII). The casting of ordnance is, however, another story.

Monumental Brasses

Monumental brasses began in the 13th century to take the place of effigies and inscriptions carved on stone. These sheets of engraved brass were let into the tombstones of the church floors where members of the great families were buried in the Middle Ages rather than, like the commoner folk, in the churchyard outside. Such brasses have often been plundered, some turned round and used afterwards for another person. The English monumental brasses survived the vicissitudes of the times more successfully than many of those on the Continent, and it is estimated that about 4,000 of them remain in English churches and are chiefly to be found in the southern and eastern counties where rich landowners, ironmasters, wool and cloth merchants and traders reached high standards of living—not forgetting the ubiquitous smugglers of the south coast areas.

An interesting sidelight upon the cult of monumental brasses is the way in which some of the Sussex ironmasters cast monumental iron slabs for the graves of their relations upon which the names and armorial bearings were shown in relief. There are in Wadhurst Church, Sussex, alone, no fewer than 26 17th and 18th century iron "tombstones," one of the finest being that of John Barham, of Shoesmiths, nearby, who died in 1648.

Equipment and Supplies

Fire-control Demonstration

In a demonstration of fire control, held recently at Cowley Bridge Works, Uxbridge, Middx, by Cape Building Products, Limited, a structure, representing three bays of a factory, remained intact after a fire, produced intentionally by igniting two tons of timber, 20 gallons of paraffin and some rubber tyres.

The structure was lined with "Asbestolux" asbestos-insulation board and a fusible-link-operated asbestos-cloth curtain, made by the Cape Asbestos Company, Limited, was fixed on a roller in the ceiling. Dual-purpose fusible-link heat- and smoke-exhaust ventilators, made by Colt Ventilation, Limited, were also located in the roof.

The heat of the fire burning inside the structure melted a fusible link which released the asbestos curtain, completely cutting off the third bay from the two in which the fire was raging. A few seconds later fusible links in the "hot" compartment, set to operate at 70 deg. C., opened the exhausts in the roof, through which smoke and heat were drawn—upwards instead of along the factory.

Cold Cabinet

The behaviour of castings at low temperatures encountered in service is becoming increasingly important, and to assist firms in research into such properties, Lec Refrigeration, Limited, of Bognor Regis, Sussex, have placed on the market a controlled-cold cabinet for industrial use. The equipment, shown in Fig. 1, is claimed to be able to maintain temperatures within the range of −100 to +250 deg. F., under compensated-automatic control. A range of four models is available with varying capacities and temperature ranges; all of these are fitted with two hermetically-sealed refrigeration units in cascade operation with proprietary refrigerants—Arcton 3 and 4. Optional equipment is available as follows: vacuum-sealed windows; positive air-circulation; stainless-steel liner; recording instruments, and terminal pads. The unit is totally enclosed within a heavy-gauge welded cabinet, sealed against atmospheric and humidity ingression, and mounted on four glider wheels to facilitate manœuvrability.

Shunting Tractor

Massey-Harris-Ferguson (London), Limited, from 35, Davies Street, London, W.1, announce that a model "35" tractor has been fitted with a Sturdiluxe shunting attachment and a Stormguard cab for working in a large Midland industrial concern. The shunting attachment, which weighs 9 cwt., has forged-steel towing hooks fitted to both front and rear plates; when not in use, the hooks swing flush into recesses provided. The main thrust members are constructed of 7-in. steel channel, stiffened and bolted to the rear-axle housing, using existing holes. Each buffer plate is of ⅜-in. section mild steel, box ribbed to resist impact loading, all electrically welded and bolted to the main thrust members at four points; easily replaceable wooden impact blocks have been fitted to the buffer plates at front and rear.

Horizontal Band-saw

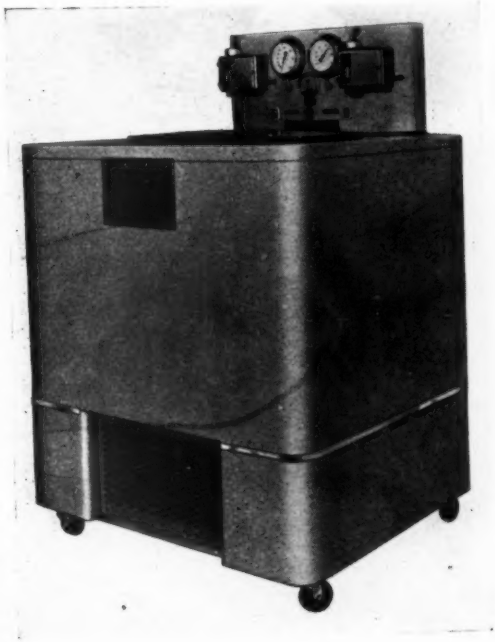
Startrite Sales, Limited, Waterside Works, Gad's Hill, Gillingham, Kent, announce that they are now marketing the Barson-Rollox horizontal band-saw, which is claimed to accelerate cutting compared with power-operated hack-sawing, together with increased blade life and reduced cutting waste. The equipment incorporates a device which permits the blade to "see-saw"; this is stated to eliminate feed-pressure adjustment. Three speeds are available through a stepped-pulley arrangement, and the equipment is fitted with a coolant pump and vice, the capacity of which is 6-in. dia. or 9 by 6-in. flat.

FEDERATED FOUNDRIES, LIMITED, have placed a space-heating stove on the market, sold under the trade-name of "The Sunglow." The stove, which is claimed to be able to burn continuously and economically (0.5 to 1.6 lb. per hour) with all fuels, is designed for heating rooms from 1,750 to 2,750 cub. ft. volume.

MUREX WELDING PROCESSES, LIMITED, Waltham Cross, Herts, have developed a new electrode, known as the "Fortrex 35A" for the welding of large vessels with walls of extra-thick plate. It is an all-position electrode, said to be simple to use, to facilitate slag removal, and to have weld metal of sound radiographic quality.

LATEST ADDITION to the range of Hylo vices, for which Alfred Herbert, Limited, Edgwick Works, Coventry, are the sole agents, is the Twin-Six, which has two independent 6-in. wide sliding jaws, each actuated by an automatic differential two-speed mechanism. Contact with the work piece automatically changes the pitch to 1/10 in. advance per revolution of the handle. The two-speed device is fully automatic and operates at any point between fully opened and closed, a distance of 12½ in.

FIG. 1.—*Controlled-cold cabinet manufactured by Lec Refrigeration, Limited, Bognor Regis, Sussex; it is designed to maintain temperatures within a range of −100 to +250 deg. F.*



Notes from the Branches

Slough

"Standing room only" meant a record attendance at the opening meeting of the 1957/58 session of the Slough section of the London branch of the Institute of British Foundrymen held on October 8. The president, Mr. A. R. Parkes, first introduced individually the distinguished panel of experts who formed a "Brains Trust" with "The Know-how of the CO_2 Process" as their subject. The panel consisted of Dr. D. V. Atterton of Foundry Services, Limited, Mr. A. Talbot of Western Foundries (London branch president), Mr. J. L. Rice of the Harlow Metal Company, and Mr. A. Lovat of British Industrial Sands, Limited.

The serious business of the evening commenced with a short discourse by each member of the panel in turn on his own particular field of the process—Mr. Talbot making the cardinal point that the present status was such that he preferred the phrase "CO_2 Practice" to CO_2 Process. After these short introductory remarks, members came forward with many and varied questions for the panel to answer, which they did without any hesitation, using slides to illustrate some of the more interesting replies.

Pertinent Points

Possibilities of reclamation of the sand brought a number of questions from the members—received with very mixed feelings by the panel. It was thought that although it *is* possible to reclaim CO_2 sand, the saving would be negligible. However, the meeting was told that as much as 85 per cent. soluble material in the sand could be disposed of by the wet method, the cost being upwards from about 3s. 6d. per ton treated—this depending very much on amounts and methods used. The disposal of the waste slurry after washing was a big problem which had to be taken into consideration.

To a question asking what percentage the CO_2 practice might displace other foundry methods, the panel would not commit themselves; they were, however, unanimous in saying that although it had displaced quite a large percentage it would never be "the method to end all others," but would settle down and take its rightful place in the industry.

Contamination of the green-sand system in a foundry by spent CO_2 sand was a worry of some foundrymen using the process; the panel answered that if a careful check were kept on the sand there was very little to worry about. In fact, it was stated that in the USA some operators report that a certain amount of contamination could be beneficial to the green-sand system.

When, with much reluctance, the chairman had at last to bring the proceedings to a close, he stated that the meeting had had the privilege of listening to some of the best authorities in the world on the CO_2 Process, and it was a great pity the meeting could not have continued longer.

A MERGER is announced between the British firms of James North & Sons, Limited, Godley Mills, Hyde, Cheshire, James North Export, Limited, and Jomac Incorporated of the USA. North-Jomac, Limited, the new company in the United Kingdom, will manufacture and distribute Jomac products here, while Jomac-North Incorporated has been set up in the United States to do the same for North products there. In Canada, James North Canada Company, Limited, is owned jointly by Jomac and North, producing and distributing both ranges.

New Patents

(Copies of complete specifications are obtainable from the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s. 6d.)

779,094. British Thomson-Houston Company, Limited, Crown House, Aldwych, London, W.C.2.

Centrifugal casting of squirrel-cage windings into the slots in assembled laminations for the production of rotors for induction motors.

779,165. Hermann Sauter and Wilhelm Hahn, trading as Hahn and Kolb, Stuttgart, Germany.

A method of producing metal castings by pressure-die-casting. The invention is designed to enable a small number of articles to be produced cheaper and quicker when the construction of a permanent mould is unwarranted. The mould, made of a refractory material capable of hardening, is formed within a compression-resisting jacket by heating so as to remove an invested pattern therein. The jacketed mould is introduced into a cavity in one die part of a pressure-die-casting machine closely fitting the jacket and then charged with molten metal under pressure.

779,393. W. S. Williams, J. H. V. Williams, and J. H. Williams, Bryncoed House, Tirdeunaw, Swansea.

Manufacture of carbon steel by the injection of oxygen through a lance-tube in the batch of molten iron. The oxygen blowing is continued until the oxygen ceases to flow through the lance.

779,544. Thompson Products Inc., 23555, Euclid Avenue, Cleveland, 17, Ohio, USA.

Cast valve-seat inserts of the type used in internal-combustion engines.

779,591. Ford Motor Company, Limited, 88, Regent Street, London, W.1.

An economical family of alloys usable in the temperature range up to 815 deg. C. These are austenitic iron-base alloys in which nitrogen is used as an alloying element, in order to gain the benefits of its intense austenizing power, ready availability and low cost. The nitrogen also imparts hot-strength impact resistance and is a potent grain refiner.

779,656. Gebr. Bohler & Company, A.G., Elisabethstrasse, 14, Vienna, 1, Austria.

Lowering rolls for feeding billets in continuous-casting plants.

779,704. H. B. Hallsworth, 53, Lichfield Road, Bloxwich, Staffs.

A foundry moulding machine as claimed in Patent No. 723,902 (*q.v.*), but in which the indexing mechanism controls the operation of fluid-control-valve mechanisms. This in turn serves to control the supply of fluid pressure from a source of supply of pressure fluid to fluid-operating means at the stations.

779,705. A. J. Moore, 4, Purley Bury Close, Purley, Surrey.

An improved method of die-casting. An insert of more highly heat-conductive metal than the metal from which the wall of the die is formed, is located in the wall of the die or core, at a position corresponding to a thicker section of the casting to be cast in the die.

PATERSON ENGINEERING COMPANY, LIMITED—Mr. Sidney W. Burrels has been appointed to the board.

Company News

VICKERS, LIMITED—Underwriters of the rights offer have been called upon to take up 94.2 per cent. of their participations. The offer of 11,772,756 £1 ordinary shares at 33s. each on a two-for-five basis was underwritten by Morgan Grenfell & Company, Limited, before the increase in the Bank rate.

ALEXANDER STEPHEN & SONS, LIMITED, marine engineers and shipbuilders, of Glasgow—The company is raising its dividend by 2½ per cent. to 12½ per cent. with a final for the year ended March 31 last of 10 per cent. The net profit of £195,840 compares with £182,940 after tax of £217,511 (£222,758).

DESOUTTER BROS., LIMITED, pneumatic and electrical tool manufacturers, of London, N.W.9—The company has acquired for cash, 76 per cent. of the issued share capital of Lang Pneumatic, Limited, Wolverhampton. Mr. G. H. Webb, Mr. R. C. Desoutter, and Mr. S. H. Ansell are joining the board of Lang Pneumatic.

WILLIAM SUGG & COMPANY, LIMITED, gas engineers and non-ferrous founders, etc., of London, S.W.1—By halving the final payment to 5 per cent., the company is cutting its dividend for the year ended June 30 to 10 (15) per cent. However, a capital distribution of 2½ per cent. net (nil) is to be paid. Group net profit is £3,487 (£14,830) after depreciation and tax.

ANTI-ATTRITION METAL COMPANY, LIMITED—Mr. S. J. Patmore is urging those shareholders in the company who have not accepted the offer by Beyer, Peacock & Company, Limited, Manchester, to remain non-assenters. The offer closes on October 27 and the directors of Beyer, Peacock have stated that some 80 per cent. have accepted. Mr. Patmore says that the next step should be to seek representation on the Anti-Attrition board.

CARRIER ENGINEERING COMPANY, LIMITED—The company announces a final dividend of 25 per cent. to make 45 per cent. for the year ended June 30, on a capital increased by a two-for-three scrip issue. This represents an effective increase of 15 per cent. over the 50 per cent. paid on the old capital for 1955-56. Profits expanded from £507,633 to £568,319. Tax absorbs £297,404 (£256,621), leaving a net profit of £270,915, compared with £251,012.

STOTHERT & PITT, LIMITED, engineers, ironfounders, etc., of Bath—The company is repeating 17½ per cent. with a 12½ per cent. final on the £1,000,000 ordinary for the year to June 30. The £500,000 ordinary issued free on a one-for-two basis do not participate. Group profits expanded from £638,227 to £904,311, with the 1955-56 balance struck after deducting £138,663 in respect of losses of former overseas subsidiaries, now trade investments. Of the loss, £84,603 was applicable to outside interests. Net profit is £488,052 (£296,436).

THOS. W. WARD, LIMITED—With an unchanged final dividend of 10 per cent., a bonus of 5 per cent. (nil) is announced to make 20 per cent. for the year ended June 30 last, against 15 per cent. After tax of £1,452,623 (£1,366,483), the group net profit is £1,249,002 (£1,242,697). The 1956-57 group profit is inclusive of £50,000 brought back from the subvention payment made last year. The group profit for 1955-56 is stated after deduction of £100,000 for a subvention payment which has subsequently been adjusted to £50,000.

MONSANTO CHEMICALS, LIMITED—A public issue of £3,000,000 6 per cent. debenture stock, 1977-82, at 95, is to be made. The application list opened and closed on October 15. To provide for the creation of the debenture stock, holders of the £3,500,000 5 per cent. unsecured loan stock, 1982, have agreed to its conversion into 5 per cent. debenture stock, 1982. The first step in revised expansion plans is to expand manufacturing facilities of established products. The revision has been made in the light of the European Free Trade Area proposals.

JOHN DALE, LIMITED, makers of non-ferrous tubes and castings, of London, N.11—Subject to CIC consent, it is proposed to issue 500,000 5s. ordinary shares, 400,000 of them to ordinary shareholders by way of a two-for-five rights issue. The remainder will be offered to the ordinary shareholders and the convertible unsecured loan stockholders. The issue is to provide funds to replace the temporary bank facilities obtained for the purchase of the shares in Modern Containers, Limited, the cost of which (with $Can.20,000 estimated for purchase expenses) is $Can.913,061, or £341,560 at the rate at which the dollars were acquired. An extraordinary meeting is called for October 28 to increase the authorized capital.

New Chairman for Bristol Aircraft

In succession to Mr. C. F. Uwins, Rear-Admiral Sir Matthew Slattery, chairman and managing director of Short Bros. & Harland, Limited, has been appointed chairman of Bristol Aircraft, Limited. Mr. Uwins has been appointed deputy chairman of the parent company, the Bristol Aeroplane Company, Limited, of which Sir Matthew has also been made a director.

It is stated that one of the objectives of the appointment is to carry further the progress of co-operative working between the two companies, Bristol Aircraft having a shareholding in Short Bros. & Harland.

Sir Matthew was first invited to take up the Bristol appointments some months ago by Sir Reginald Verdon Smith, chairman and joint managing director of the Bristol Aeroplane Company, but he had accepted the Prime Minister's invitation to act as special adviser on the transport of Middle East oil after the Suez crisis. He is also chairman of Short Bros. (Realisations), Limited.

Mr. R. E. Harvey, a director and general manager of Short Bros. & Harland, and Mr. H. G. Conway, a director and chief engineer, have both been appointed deputy managing directors of the company. The appointments are designed to relieve Sir Matthew Slattery of part of the burden of looking after Short's affairs in addition to his new posts. Sir Matthew remains chairman and managing director of Short Bros. & Harland.

More Jobs than Jobless

With a slight rise of 2,000 in the numbers of unemployed in September, the peak demand for labour appears to have passed The number of unfilled vacancies dropped by 26,000 to 284,000, and there were 267,000 unemployed. Vacancies have exceeded unemployed since June. At the end of August 1,535,000 workers on overtime were 25,000 more than in May and 160,000 more than a year ago. Those on short time totalled 39,000, a drop of 2,000 on the previous month and considerably less than the 112,000 in August, 1956.

Almost all sections of industry gained workers, but the great bulk of the increase (47,000) came from manufacturing. The engineering and metal goods group increased its labour force by 20,000, and vehicles by 9,000.

Personal

Mr. J. Cross has been appointed a director and general manager of Richard Sutcliffe, Limited, mechanical handling engineers. of Horbury, Wakefield.

Mr. Frank Crawshaw has retired from the position of foreman patternmaker at the David Brown Gears (London), Limited. He had spent nearly 51 years with the company, and of these he was foreman for 33 years.

Mr. Peter Higgins, president of the Association of Bronze & Brass Founders, is to represent that body at a meeting of the European Committee of Foundry Associations being held in Amsterdam tomorrow (October 25).

Miss Winifred Lister, accounts clerk at the Moorhead branch of Newton, Chambers & Company, Limited, Sheffield, has retired after 41 years with the company. Miss Lister, both of whose parents were employed by the company, received a work-box from colleagues.

Mr. J. Hartley-Taylor, formerly export manager for the Firth Cleveland group of machine-tool manufacturing companies, has been appointed commercial head of the Surform tools division of Simmonds Aerocessories, Limited, specialized aeronautical and engineering accessory manufacturers of Pontypridd (Glam).

Mr. Adrian Liddell Hart has been appointed chief information officer of the Federation of British Industries, directly responsible to the director of home services and information, Mr. W. P. N. Edwards, for all aspects of the federation's information work, including Press and public relations, at home and overseas.

Mr. Anthony V. Wilkin has been elected chairman of the Council of the British Internal Combustion Engine Manufacturers' Association for 1957-1958. Mr. Leonard P. Lee has been elected vice-chairman. These appointments follow the retirement of Mr. Norman McCallum, who has been chairman since June, 1955.

Last Thursday, Mr. L. K. Jha, special secretary to the Minister of Commerce, India, left this country for Germany. He had been here since October 11 accompanying the Indian Minister of Finance. During his stay he met a number of representatives of UK firms, including Sir Norman Kipping, president of the Federation of British Industries.

Mr. P. H. W. Everitt, works manager, and Mr. A. J. Haselfoot, chief design engineer, have been appointed to the board of Fuller Electric, Limited, London, E.17, Mr. D. N. Dow has been appointed secretary. Mr. L. Berry succeeds Mr. Dow as secretary of Mirrlees, Bickerton & Day, Limited, Stockport. Both companies are subsidiaries of the Brush Group, Limited.

Following the retirement of Mr. A. D. Dorrington as chairman and Mr. Stanley Maddock as sales director, Jackson Boilers, Limited, Leeds, have announced the following appointments: chairman, Mr. David Brooke; managing director, Mr. C. W. Mustill; sales director, Mr. F. Cooke; works director, Mr. E. Gudgeon. The director and secretary is Mr. E. C. King.

British Iron and Steel Federation announce the appointment of Mr. Lewis Chapman, C.B.E. (chairman William Jessop & Sons, Limited), as president-elect of the Federation in succession to the late Mr. Gerald Steel, C.B.E. Sir Andrew McCance, F.R.S. (chairman and managing director, Colvilles, Limited) has been invited to continue in office as president of the Federation for 1958.

To mark the 70th birthday last week of Mr. Harry Johnson Foster, the founder 26 years ago, of H. Johnson Foster, Limited, steel manufacturers and founders, of Sheffield, employees presented him with a musical cigarette box, an ash tray, and a lighter. The presentation was made by one of Mr. Foster's five first employees, Mr. George Gascoyne, who, at 69, is still with the company.

Mr. G. W. S. Burdett, technical managing director of G. W. S. Burdett & Company, Limited, machine-tool manufacturers, of Peterborough, has been elected president of Peterborough Engineering Society in succession to Mr. W. G. Wright, of J. P. Hall & Sons, Limited, pump manufacturers. Mr. Burdett founded the firm some 35 years ago and was previously president of the Society for 1947-48.

Mr. C. W. Sharp, managing director of Electro-Hydraulics, Limited, and Conveyor Fork Trucks, Limited, both of Warrington, and members of the Rubery, Owen group of companies, left last Tuesday for a tour of Canada, New Zealand, and Australia, with calls at Singapore, Rangoon, and Calcutta. Visits will be made to the companies' subsidiary plants in Sydney and Toronto.

On behalf of the Governing Board of the American Institute of Physics, Prince Philip conferred the first Karl Taylor Compton gold medal of the Institute on Dr. George Braxton Pegram, vice-president Emeritus of Columbia University. The ceremony took place on October 21 in conjunction with the dedication of the Institute's new building at 335, East 45th Street.

Samuel Fox & Company, Limited, Stocksbridge, near Sheffield, a subsidiary of the United Steel Companies, Limited, announces the appointments of Mr. D. N. Riley as manager of its Rotherfield works and Mr. E. E. Beard as manager of the laminated and coil spring departments. Mr. A. Aspinall is to be transferred from the Rotherfield works to become assistant manager of the laminated and coil spring departments at Stocksbridge. Mr. E. Hampshire, technical superintendent, spring manufacture, is being given certain additional technical and liaison duties in connection wth the umbrella department.

Obituary

The death has taken place of Mr. George Herbert Marchant, senior director of the family firm of G. M. Marchant, Limited, iron and brass founders, and valve manufacturers, of Huddersfield. He was 71.

The death occurred on October 12, at the age of 80, of Mr. Samuel Nield Yeadon, who was a partner with his son, Mr. J. N. Yeadon, in the engineering firm of Yeadon, Son & Company, Albion Street, Leeds.

Mr. Charles Marriott, a former blast-furnace foreman and manager for 40 years at the Holwell Ironworks, Melton Mowbray (Leics), of the Stanton Ironworks Company, Limited, has died at the age of 77. Starting work at Holwell when he was 20, Mr. Marriott was a furnace foreman for 38 years, and became furnace manager two years before he retired.

Mr. Leonard L. Parkin, office manager of the stainless steel department of Brown Bayley Steels, Limited, Sheffield, died on October 9 at the age of 54. He joined the company in 1917 and spent all his career in the commercial office. He was appointed manager of the stainless steel department in 1941. Mr. Parkin was for many years the firm's representative to the Sheffield section of the National Trades Technical Societies.

News in Brief

HIS ROYAL HIGHNESS, Prince Philip, visited the works of Hadfields, Limited this morning. He was received by Lieut. Colonel Lord Dudley Gordon, the chairman, and the itinerary included an inspection of the foundry.

A TEAM of five from Vickers, Limited, left for Peking this week, to discuss the reopening of trade relationships with China. They will investigate the possibility of marketing some of the commercial products of the Vickers group in that country.

AN INITIAL ORDER for the conversion of 25 Yugoslav 3-ton trucks to diesel traction has been received by F. Perkins, Limited, Peterborough. Yugoslavia has already standardized on Perkins engines for imported agricultural machinery and for its home-built Zadrugar tractor.

THE AUSTRALIAN JOURNAL, *Castings*, announces that Thomson and Scougall Industries, Limited, have acquired the St. Peters foundry of Lister Blackstone Pty., Limited—a subsidiary of R. A. Lister and Company, Limited. It is stated that the deal was thought to involve £A200,000.

FROM UGANDA it is reported that a steel foundry may be built at Tororo. The Uganda Development Corporation is considering a scheme and, if it is adopted, it is likely that the foundry will at first convert local scrap into steel. Later on, however, deposits of magnetite in the Tororo area may be utilized.

AT THE AUTUMN CONGRESS of the *Bureau International de la Recuperation* which will be held on November 7 and 8 in London, the business sessions and the combined section luncheon will take place at the Charing Cross Hotel, Strand, W.C.2, and the official dinner/dance will be held at Grosvenor House, Park Lane, W.1.

OMNI (LONDON) LIMITED, 35, Dover Street, London, W.1 announce that they have been appointed the exclusive agents for the J. T. Baker Chemical Company, Phillipsburg, New Jersey. This American company manufactures a wide range of fine and industrial chemicals, which includes molybdenum chemicals and aluminium hydroxide.

THIRTEEN 400 h.p. diesel-electric locomotives, constructed by the Birmingham Railway Carriage & Wagon Company, Limited, and fitted with Crompton Parkinson, Limited, electrical equipment, have been purchased and put into service in the Takoradi Harbour area by the Ghana Railways Commission. They are for shunting and light passenger-train work.

FIRST 21 cub. yd. scraper to be produced by Euclid (Great Britain), Limited, came off the assembly line at the Newhouse (Lanarkshire) factory recently. The machine digs, transports, and dumps 30 tons of earth at a time and is three times the size of previous Euclid scrapers. It represents the first result of the company's expansion programme, which involves an investment of over £2,000,000 exclusive of buildings.

SIX BAHRAINI SUPERINTENDENTS from the Bahrain Petroleum Company, Limited, will visit Security Rock Bits, Limited, Manchester, to-day. On the following day the party will visit the English Steel Corporation, Limited, Sheffield. The group, which is led by Mr. M. Bowler, the company's co-ordinator of training, is on a study tour of a wide variety of industrial concerns in England and Scotland under the auspices of the Industrial Welfare Society.

THE RESEARCH COUNCIL of the Department of Scientific and Industrial Research has decided to replace the present Fuel Research Station at Greenwich, where it would be uneconomic to spend more money on the buildings, by a new research station at Stevenage. This decision has led to a very careful review of the present-day needs for research and in consequence the programme of the new station will differ markedly from that of the old one.

AN ORDER worth some £250,000 for the supply of eight high-speed cargo handling cranes for Capetown Harbour, South Africa, has been secured by Cowans, Sheldon & Company, Limited, Carlisle. Arrangements have been made for most of the structural work to be fabricated in Capetown, but all the machinery will be manufactured in Carlisle. Most of the cranes at present operating in Capetown Harbour were designed and manufactured by the company.

AWARDS IN 10 CATEGORIES judged at the Harrogate Festival of Films in the Service of Industry were presented by Dr. Charles Hill, Chancellor of the Duchy of Lancaster. The film "Golden Minutes," made for Wolf Electric Tools, Limited, by United Motion Pictures, received first prize in the "Sales and Dealer Training" category, while "Introducing Work Study," made for the British Productivity Council by World Wide Pictures, received first prize in the "Industrial Productivity" category.

THE SIXTH MEETING of the Council of Association between the United Kingdom and the European Coal and Steel Community will take place in Luxembourg to-day. The UK delegation will be headed by Mr. Reginald Maudling, Paymaster-General, on behalf of the Minister of Power, and Mr. John Vaughan-Morgan, Minister of State, Board of Trade, together with Sir James Bowman, chairman of the National Coal Board, and Sir Archibald Forbes, chairman of the Iron and Steel Board.

A CONTRACT for the construction of a new 850-ft. long deep-water berth and quay at the north dock, Sunderland, has been given to Melville Dundas & Whitson, Limited, Glasgow, by T. W. Greenwell & Company, Limited, shiprepairers, of Sunderland. The new quay, which will take about two years to build, will be capable of accommodating two supertankers. The company's existing quay at south docks, which was extended to a length of 800 ft. in 1952, is severely taxed at times of peak repairing activity.

IN RESPONSE to numerous requests from South Africa, the Board of Trade are considering installing a United Kingdom pavilion for the Rand Easter Show of 1959. A timetable for design and construction has been prepared, from which it is clear that, if the pavilion is to be ready in time, a decision must be taken by November 15 next. Firms interested in exhibiting in South Africa should write immediately to the Export & Fairs branch of the Board of Trade, Lacon House, Theobalds Road, London, W.C.1, quoting reference E & F 280/56.

THE IRON AND STEEL INSTITUTE are holding a joint meeting with the Sheffield Society of Engineers and Metallurgists and the Sheffield Metallurgical Association on November 28, in the department of Metallurgy of Sheffield University. One paper of foundry significance is to be given by Mr. W. J. Jackson and Mr. G. M. Michie. It deals with the "Low-temperature Impact Properties of Cast Steel." In the evening at the Firth Hall, Dr. Paul Bastien, scientific director of the Schnieder concern, is to deliver the tenth Hatfield Memorial Lecture. His subject will be the "Mechanism of the Formation of Bonded Structures in Steel."

THE JAPANESE Ministry of Trade has announced that it will set up an industrial design section to supervise checking of designs to prevent copying of foreign

News in Brief

goods. Up to now, it is stated, design checking has been done only by industrial and private associations. Mr. John L. King, managing director of Pollard Bearings, Limited, Ferrybridge, Knottingley (Yorks), said recently that a Japanese firm was using the name "Bollard" on bearings sold in Burma and Malaya, and the Japanese Foreign Ministry subsequently admitted that a Japanese manufacturer had made and exported ball bearings in packages liable to violate foreign trade market rights.

ADDRESSING MEMBERS of the Federation of British Industries in Birmingham recently, Mr. A. E. Tarrant, a New Zealand representative of the FBI advised Britain to put its export markets in New Zealand into "closer focus." He said that manufacturers should increase the tempo of their sales drives which last year earned £140,000,000 in exports. He added that Australian exports to New Zealand had risen from £30,000,000 to £40,000,000 a year as a result of new sales campaigns and that duties against Japanese goods entering New Zealand were being eased to bring them into line with other non-Commonwealth imports.

RECENTLY the first blast furnace of the Aviles Steel Works, the major undertaking of the official Spanish organization, the National Institute of Industry, was opened by General Franco. The widest publicity has been given to the inauguration and it has been regarded by the Press as a turning point in the industrialization of Spain. Constructed by a British firm, the new plant is the latest and most modern installation of its kind in Europe. This new factory will employ some 5,000 workers and it is expected that during the remaining months of 1957 it will produce some 80,000 tons of pig-iron, while for the whole of next year, during the middle of which a second blast furnace should be brought into production, total output is expected to rise to 400,000 tons.

A MOBILE UNIT from the Egham technical service laboratories of Shell Chemical Company is touring the country, demonstrating the applications of "Epikote" resins in the engineering industry. Many firms are already using these resins with success for press tools and foundry patterns. Other firms, which may be less familiar with the techniques for making resin tools, can take advantage of this unit which will give demonstrations on their own premises. This will save time for the manufacturer and will enable the methods demonstrated to be modified to suit the conditions existing in a particular works. It is hoped to extend this service in future to cover the rest of the country. Companies wishing to know more details should apply to the Shell Chemical sales office in their area.

Mr. RAYMOND CHERADAME, technical general manager of the *Centre d' Etudes et Recherches des Charbonnages de France*, was this year's "Coal Science Lecturer"—an annual event organized by the British Coal Utilisation Research Association. In the course of his remarks he mentioned that the reactivity of coke has been selected by the French *Centre* for inclusion in future fundamental research, and in this connection the French have already developed an original technique, by means of which it is possible to measure reactivity of coke to CO_2 at temperatures of 1,200, 1,300 and 1,400 deg. C. These reactivities appear to correlate reasonably well with the performance of foundry cokes; some other properties, such as porosity, have been measured in various ways during the course of the same work.

Indian Metallurgical Developments

The following firms are among those which have been granted licences under the Indian Industries (Development and Regulation) Amendment Act, 1956, for the establishment of new industrial undertakings, the expansion of an existing industrial undertaking and/or the manufacture of a new article (*i.e.* an article which is not included in the list of a firm's manufactures for which a licence has already been issued). A statement issued by the Indian Ministry of Commerce and Industry contained particulars of licences which had been granted during the period March to May, 1957. It should be noted that in the past there has often been a considerable lapse of time between the issue of a licence and the commencement of production.

Iron and Steel (General).

—	Location.	Lines of manufacture and capacity sanctioned, per annum.
(*a*) *New Undertakings*		
Britannia Engineering Co. Ltd.	Barauric (Bihar)	9,000 tons of steel factory structures, including light steel bridges, signal posts for railways, etc.
Textool Co., Ltd., Coinbatore	Coinbatore Madras	Pig-iron, 15,000 tons
(*b*) *Substantial Expansions and New Articles*		
Indian Iron & Steel Co., Ltd., 12, Mission Row, Calcutta, 1	Kulti (Burdwan), West Bengal	Cast-iron pipes, 7,200 tons; steel castings, 3,000 tons
Kalinga Industries, 33, Chittaranjan Avenue, Calcutta	Orissa	Pig-iron, 15,000 tons; ferro-manganese, 7,500 tons; and ferro-chrome 7,500 tons
Iron and Steel Castings.		
(*a*) *New Undertakings*		
Nandlal Todi, 32, Ezra Street, Calcutta, 1	Bihar	Cast-iron spun-pipes, 12,000 tons
(*b*) *Substantial Expansions and New Articles*		
Dhansar Engineering Co., P.O. Dhansar District, Manbhum	Bihar	1,800 tons of steel castings
(*d*) *Change of Location*		
Indian Iron & Steel Co., 12, Mission Row, Calcutta, 1	Kulti (Burdwan) West Bengal	Changing of location. Steel castings, 5,400 tons
Structural Iron and Steel.		
(*a*) *New Undertakings*		
National Bearing Co., Jaipur	Rajasthan	1,000 Railway wagons, Nos. and structurals, 12,000
Iron and Steel Pipes		
(*b*) *Substantial Expansions and New Articles*		
Richardson & Cruddas	Bombay	Cast-iron spun-pipes, 24,000 tons
Richardson & Cruddas, Ltd., Madras	Madras	Cast-iron spun-pipes, 24,000 tons
Structural Engineering Works, Ltd., Bombay	Bombay	7,200 tons cast-iron pipes
Lakshmiratan Engineering Works, 17, Keeling Road, New Delhi	Faridabad Punjab	Cast-iron spun pipes, 12,000 tons

Enquiries relating to this circular should be addressed to Export Services Branch, Board of Trade, Room 746, Lacon House, Theobalds Road, London, W.C.1 (telephone CHAncery 4411, extension 732), quoting reference ESB/16973/57.

Facts from the record

of Goodyear conveyor belting

STACKER

APPLICATIONS

A super quality belting for use where there is severe and frequent abrasion and flexing. It is ideal for conveying ores, stone, coke, glass cullet and other highly abrasive materials.

PHYSICAL PROPERTIES

Stacker exceeds British Standards Grade "A" in all requirements of fabric and rubber and may be used at temperatures up to 200 deg. F.
Made with the highest grade friction stock between plies for maximum flex-life.
Has the toughest cover obtainable, with the highest possible resistance to cutting, gouging and abrasion.
Completely inhibited against mildew damage.

AVAILABLE

Stacker is available in 28, 32, 36, 42 and 48 oz. duck weights, from 3 to 9 plies and in a full range of widths, lengths and cover gauges.

STYLE ORS

APPLICATIONS

For operations where extreme resistance to oil is necessary. Especially suitable for carrying oil-sprayed co
meat, fish or food where an

PHYSICAL PROPE

STYLE HRS

APPLICATIONS

Specially made for conveying hot, highly abrasive materials when the combination of resistance to high temperatures, extreme abrasion and severe flexing are essential.

PHYSICAL PROPERTIES

The carcass, cover and skim-coating between plies give all the heavy-duty characteristics of a Grade A

GOODYEAR
INDUSTRIAL RUBBER PRODUCTS

CONVEYOR BELTING · TRANSMISSION BELTING · V-BELTS · HOSE · FENDERING

Raw Material Markets

Iron and Steel

With adequate supplies of raw materials available at the blast furnaces, stocks on hand of iron ore being the highest they have been for some time, production of pig-iron is maintained at high levels. Average output for the first nine months of the year exceeds by some 169,000 tons the target for the year of 14,000,000 tons, and it is expected that there will be no difficulty in keeping up this production for the remaining three months. The tonnages available in all grades are more than sufficient to meet current demands.

The steelworks are much the biggest users, taking more than three quarters of total outputs, and they continue to be mainly dependent on basic pig-iron for their outputs of steel ingots, their mixtures consisting of more pig-iron than scrap. Deliveries of basic pig-iron are satisfying all requirements, and, if the necessity arose, increased tonnages could be supplied by the furnaces. For the present they are not dependent on imports, as was the case a short time ago, and the tonnages which are being received from abroad are helping to build up a useful stock.

Outputs of most foundry pig-iron grades exceed demands and only in the low-phosphorus irons is the call for supplies approaching production. In this grade of pig-iron, which is used mainly by the engineering and speciality foundries for the production of high-duty castings for many trades, outputs are practically fully absorbed and there is little to spare.

Appreciable tonnages of hematite are also used by these foundries, and there appears to be little difficulty on the part of the furnaces in supplying these needs. In fact, production by most of the hematite makers is sufficient to permit of consignments being available for the export market when orders and licences can be obtained. Some demands are also made for refined irons, but these do not cover total production and makers are able to accept more business for both home and overseas users.

The moderate demands, which have for so long persisted, for high-phosphorus pig-iron, continue. Producers have tonnages to spare which are either being placed into stock or supplied to customers abroad, although competition from overseas makers is keen and orders are difficult to obtain.

Many of the light, jobbing, and textile foundries are in need of more work and, in the case of the light foundries in particular, they have had a lean time for a long period and their prospects for increased business are not very bright. The effects of the anti-inflation measures cannot yet be judged, but the restrictions which will follow are bound to have a further adverse effect on the demands for light castings from the trades on which they rely for business.

Sufficient foundry coke is being delivered for current consumption. An increase in the supply of some of the Welsh cokes would be preferred, but supplies continue scarce. Most of the foundries have adequate supplies of scrap, and ganister, limestone, and firebricks are in good supply.

Most of the re-rollers maintain steady outputs, although, in the English Midlands in particular, the demand for small bars and light sections is still much below the tonnages which were being taken up a few months ago, both by stockists and consumers. Steady demands continue, but the quantities specified are not so large as before. Reinforcing rods are still in heavy demand, and the improved call for sheets is upheld.

The supply of steel semis from home steelworks is at present satisfying practically the whole of the needs of the re-rollers, most of them having good stocks, and they are not taking up all the tonnages on offer in prime material. Arisings of defectives and crops are difficult to dispose of.

Non-ferrous Metals

Some slight stiffening of sellers' ideas of prices because of the Middle East situation was not long maintained and the trend has again been weaker in all metals.

Copper opened lower again on Monday and sentiment was not helped by the news that stocks in London Metal Exchange warehouses rose last week by 582 tons to 18,865 tons. Buyers of tin have shown no pronounced interest and buffer stock support has been necessary to maintain cash prices. Forward tin prices have eased and there is a substantial backwardation again.

Modest trading only can be reported in lead and zinc, and although prices have not changed a lot, the tendency has been for them to ease in sympathy with copper.

Public Relations in Industry

Mr. W. T. Wren, chairman of Allied Ironfounders, Limited, introducing a discussion on the use of films in public relations and prestige, at the Festival of Films in the Service of Industry, at Harrogate, said that public relations in so far as industry was concerned should come from the top—in fact from boardroom level; they were not like advertising, as they could not be analysed, dissected, and budgeted for so closely.

The attitude of individual firms, industries and public services towards the subject must vary according to the goods they sold and the service they rendered to the public, he continued. Taking as an example the activities of the British Council, Colonel Wren pointed out that the transmission of British background into foreign countries was bound to do good. If one had even a glimmering of the background of other countries—and this applied equally to companies—one at least had some understanding of the forces and motives behind that country's or company's actions.

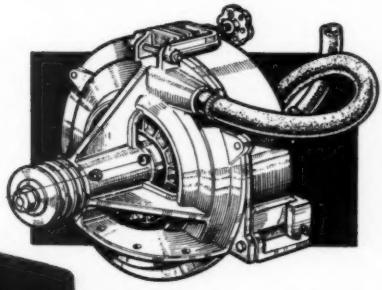
Purchasing Officers' Association

The Purchasing Officers' Association is holding an advanced purchasing course from April 14 to 19. It will be conducted by Dr. Howard T. Lewis, A.M., LL.D., Professor of Marketing, Emeritus, Graduate School of Business Administration, Harvard University. The attendance will be limited to 100 people engaged in purchasing for industrial and public undertakings, of chief-buyer, or (in the case of large organizations) deputy-chief-buyer status. The fee for attendance is £25, inclusive of accommodation and meals, and applications to participate in the course should reach the Purchasing Officers' Association, Wardrobe Court, 146A, Queen Victoria Street, London, E.C.4, by December 31 next.

A.P.V.-Paramount Limited, the stainless and alloy steelfounders of Crawley announce that Mr. G. F. SPICER, who since 1953 has operated for K. & L. Steelfounders & Engineers Limited, of Letchworth as southern-area representative, has been appointed by them to act in a similar capacity. Mr. Spicer took up this new appointment on October 1.

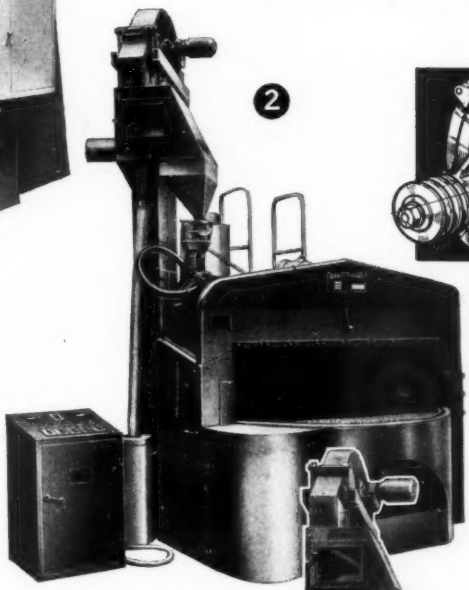
Shot Blast Equipment

This A-S-L Turbine is the most modern Shot Blasting Unit available. The bi-phase air injection system enables shot to be projected at greater speeds using lower power with fewer replacements. The economies effected in spare parts alone are very substantial.



Baker Perkins High Speed Bi-Phase A-S-L Turbine, British Patent, No. 510681.

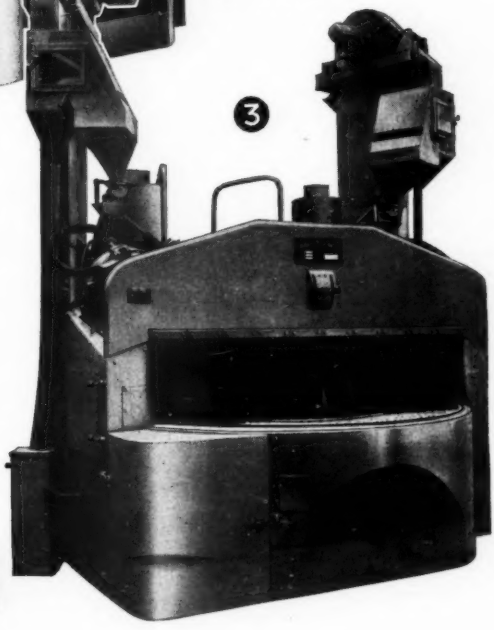
These machines do not require pits or special foundations.



1 ROTARY BARREL

2 CADET

3 MEDIUM



Our standard range of Rotating Barrel and Table Shot Blast Machines is capable of handling a wide range of Foundry products. Both types are semi-automatic, the rotating barrels being equipped with skip hoist loading gear and frontal discharge mechanism. These modern highly efficient machines are in use in Foundries all over the world, and are built to the high standards of design, materials and workmanship characteristic of all Baker Perkins' machines.

BAKER PERKINS LIMITED
ENGINEERS
WESTWOOD WORKS · PETERBOROUGH

Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

October 23, 1957

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £23 17s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £24 1s. 3d.

Scotch Iron.—No. 3 foundry, £25 3s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £25 19s. 0d.; South Zone, £26 1s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £27 6s. 6d.; South Zone, £27 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £25 6s. 6d.; Scotland (Scotch iron), Zone S. 1, £25 13s. 0d.; Sheffield, £26 15s. 0d.; Birmingham, £27 4s. 0d.; Wales (Welsh iron), £25 6s. 6d.

Basic Pig-iron.—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leics.

FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £52 15s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £76 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 9s. 2d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 12s. 2d. per lb. of W.

Ferro-chrome (6-ton lots and over).—4/6 per cent. C, £96 0s. 0d. to £99 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. per unit; over 6 per cent. C, £94 0s. 0d., basis 60 per cent. Cr, scale 31s. 0d. to 33s. 0d. per unit; 2 per cent. C,* 2s. 2d. per lb. Cr.; 1 per cent. C,* 2s. 2½d. per lb. Cr; 0.15 per cent. C,* 2s. 3d. to 2s. 3½d. per lb. Cr; 0.10 per cent. C,* 2s. 3½d. to 2s. 3¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3¾d. to 2s. 4d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 3d. to 7s. 10½d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 0d. to 23s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £87 19s. 3d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £33 1s. 6d.; tested, 0.08 to 0.33 per cent. C, £34 1s. 6d.; hard (0.41 to 0.60 per cent. C), £35 3s. 0d.; silico-manganese, £44 2s. 6d.; free-cutting, £37 5s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £41 7s. 0d.; silico-manganese, £44 10s. 0d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.33 per cent. C, £38 16s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £39 18s. 6d.; acid, up to 0.25 per cent. C, £43 10s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £42 12s. 0d.; boiler plates (N.-E. Coast), £45 2s. 0d.; floor plates (N.-E. Coast), £44 1s. 0d.; angles, N.-E. Coast, £40 6s. 6d.; joists, N.-E. Coast, £40 2s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., and flats, 5 in. wide and under, untested soft basic, 50 tons and over, £40 8s. 0d. (under 10 tons to 4 tons, £41 5s. 6d.; under 4 tons to 2 tons, £41 10s. 6d.); hoop and strip, coils, £40 10s. 0d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £45 16s. 0d.; black sheets (hand mill), 24 g., 59 4s. 6d.; galvanized corrugated sheets, 24 g., £68 17s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £69 9s. 6d., nickel-chrome, £100 12s. 6d.; nickel-chrome-molybdenum, £112 16s. 6d.

NON-FERROUS METALS

Copper.—Cash, £179 0s. 0d. to £179 10s. 0d.; three months, £182 15s. 0d. to £183 0s. 0d.; settlement, £179 10s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 1s. 9⅝d. per lb.; rods, 208s. 6d. per cwt. basis; 20 s.w.g., 241s. 9d. per cwt.

Tin.—Cash, £730 10s. 0d. to £731 0s. 0d.; three months £724 10s. 0d. to £725 0s. 0d.; settlement, £731 0s. 0d.

Lead (Refined Pig).—Second half October, £83 0s. 0d. to £83 5s. 0d.; second half January, £83 17s. 6d. to £84 0s. 0d.

Zinc.—Second half October, £67 0s. 0d. to £67 5s. 0d.; second half January, £66 7s. 6d. to £67 2s. 6d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations £102 5s. 0d.; rolled zinc (boiler plates), all English destinations, £100 0s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £85.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 6d. per lb.; sheets to 10 w.g., 162s. 0d. per cwt.; wire, 2s. 3½d.; rolled metal, 162s. 0d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £136; B6 (85/15), — ; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £182; HTB2 (38 tons), — ; HTB3 (48 tons). — .

Gunmetal.—BS1400, LG2 (85/5/5/5), £169; LG3 (86/7/5/2), £180; G1 (88/10/2/½), £239; (88/10/2/1), £225.

Phosphor Bronze.—BS1400, PB1 (A1D released), £250 per ton.

Phosphor Bronze Strip, etc.—Strip, 237s. 3d. per cwt.; sheets to 10 w.g., — per cwt.; wire, 3s. 6⅜d. per lb.; rods, 2s. 10½d.; tubes, 2s. 10½d.; chill cast bars: solids 2s. 10d., cored 2s. 11d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 5½d. per lb.; round wire, 10g. in coils (10 per cent.), 3s. 10½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 9½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £75 0s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400), AB1, £216; AB2, £239.

* Average 68-70 per cent.